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Pulmonary Function Studies*

• The value of these studies is thoroughly explained, together with their limitations. The author gives eight illustrative case histories.

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IF the definition of pulmonary function studies appears involved, still more challenging is the interpretation of the findings elicited. Pulmonary function studies are no more no less than the title implies. Briefly, they constitute a series of specialized tests calculated to evaluate the three prime functions of the lungs.

1. Ventilation
2. Diffusion
3. Pulmonary capillary blood flow.

By various charts made available through years of research by pulmonary physiologists, fairly accurate and accepted normal values have been determined for the various age, sex, height, and weight groups. With these values already established, a deviation therefrom calls for explanation. Having defined lung function studies let us now briefly review what they can and cannot do toward making a diagnosis.

What Pulmonary Function Tests Can Do

1. Provide the information needed for an objective appraisal of pulmonary impairment, insufficiency or disability when interpreted in relation to the other findings in the patient. Extensive involvement of the lungs seen in x-ray shadows may be associated with little or no pulmonary impairment while others with little roentgenological evidence of disease may have true pulmonary disability.

2. Useful in ruling out pulmonary disease in nonorganic types of dyspnea such as psychoneurosis, neurocirculatory aesthenia.

3. May provide quantitative measure of pulmonary function which can aid in the evaluation of candidates for permanent forms of collapse therapy or surgical removal of the lung tissue, both so far as immediate risk and ultimate useful existence are concerned.

4. May aid in following objectively certain aspects of the course of pulmonary disease.

5. May permit evaluation of therapeutic measures, medical or surgical.

6. Aid in differentiating primary from secondary types of polycythemia.

7. Aid in differentiating cardiac from pulmonary disease.

8. Occasionally permit detection of pulmonary abnormalities in patients in whom physical examination and x-ray

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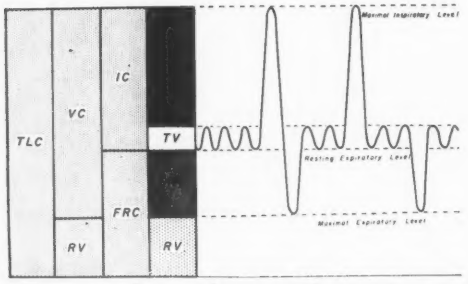

Figure 1.—Lung volumes as they appear on a spirographic tracing. Taken from "The Lung" by Comroe, Forster, Dubois, Briscoe, Carlsen, Year Book Publishers, Chicago, Illinois. (Reproduced with permission of the author and the publisher.)

studies cannot disclose certain diseases of the lung.

9. May be useful in pre-employment evaluation.

10. Aid in evaluating disability claims in insurance or industrial practice.

11. Pulmonary function studies indicate the specific function of the lung that has been impaired by disease and give the physician a clearer concept of the disease process in each patient.

What Pulmonary Function Tests Cannot Do

1. Cannot provide etiological or anatomical diagnoses but only physiological diagnoses, estimates of functional capacity, and sometimes, information of prognostic import.

2. Cannot demonstrate the definite location of a process: Thus certain tests might reveal the existence of a venous-arterial shunt but in themselves fail to identify it as intracardial or intrapulmonic.

3. Cannot distinguish between processes producing certain effects; for example, impaired diffusion across the alveolo-capillary membrane might be demonstrated but without distinguishing between alveolar edema and interstitial edema.

4. Cannot reveal pulmonary disease unless function is impaired and then only when impairment is of sufficient degree that present tests can recognize with certainty the deviation from normal values; thus slight reduction in function cannot be detected or involvement of small areas only.

5. Localized disease produces changes only when so much space is occupied or the lesion is strategically situated so that function is affected. As with other parenchymatous organs, diffuse disease is far more likely to impair function than localized lesions.

6. Cannot supplant careful analysis of the history, physical examination, fluorscopic, and other radiological examinations, bacteriological or pathological studies.

7. No single test now known is sufficient for evaluation of all aspects of pulmonary function.

8. At present sufficient data have not been obtained upon large enough groups of *healthy* persons to determine with certainty what constitutes normal values for pulmonary function in men and women of all age groups and what values represent an irreducible minimum below which patients cannot live in comfort.

Mechanics of Breathing

Perhaps the next consideration should be given to a short review of the normal mechanics of breathing. Throughout this entire discussion three of the fundamental laws of gases must be kept in mind, viz.:

1. "All gases flow from an area of higher pressure to one of lower pressure."

2. The pressure exerted by gases varies in inverse proportion to the space occupied. In other words, the larger the space the gas occupies, the *lower* the pressure it exerts.

3. The difference in partial pressures of gases comprising atmospheric air and in the circulating blood make possible the interchange of oxygen and carbon dioxide.

Hence, the *one fundamental* law of gases flowing from a higher to a lower pressure is the keynote to the understanding of lung physiology.

Dalton's Law

Dalton's law of partial pressures is one of the most significant laws to be

discussed, because from now on frequent reference will be made to the partial pressure of the gases in the air and in the blood. The law of partial pressure states that in any mixture of gases each gas behaves as though it were the only one there, and exerts the same pressure (called its "partial pressure") which it would ordinarily exert if it were alone in the container.

The atmosphere exerts a pressure of 760 mm. Hg. at sea level and is composed of oxygen (20.96 per cent), Carbon dioxide (0.04 per cent) and nitrogen (79.0 per cent).

The partial pressure of oxygen gas, therefore is

$\frac{20.96}{100} \times 760$, or 159.2 mm. Hg.* for carbon dioxide,

$\frac{0.04}{100} \times 760$, of 0.30 mm. Hg.: and for nitrogen,

$\frac{79.0}{100} \times 760$, or 600.4 mm. Hg.

It is generally accepted that partial pressures of alveolar gases are practically identical with arterial partial pressures.

Inspiration and Expiration

In the process of normal breathing, purely from a ventilatory standpoint, just what takes place upon—

1. Inspiration
2. Expiration

This function is easily performed and does not require excess work. Any alteration of these various factors affects the ventilatory function of the lungs, such as,

1. A break in the pleural seal.
2. A fusion of the pleurae.
3. Paralysis of one leaf of the diaphragm.
4. Neurogenic factors associated with bulbar polio.
5. Impairment of normal elasticity of bronchi, alveoli and chest wall.

Some of these abnormalities may be obvious. Others require pulmonary function studies of various extent to establish. The studies become valuable from a quantitative standpoint.

* Not corrected for water vapor.

Diffusion

In the process of breathing from a purely "diffusion" standpoint what takes place in the *normal* individual?

1. Adequate ventilation of each alveolus.
2. Lack of obstruction of the bronchiole leading to each alveolus.
3. Good elasticity of each alveolus.
4. Lack of fluid or exudate in alveolus.
5. Free mixing of alveolar gas.
6. Thin alveolar membrane.
7. Normal partial pressures of O_2 and CO_2 in each alveolus.
8. Adequate perfusion of each alveolus with blood.

Any variation from the normal as shown above, results in inadequate diffusion.

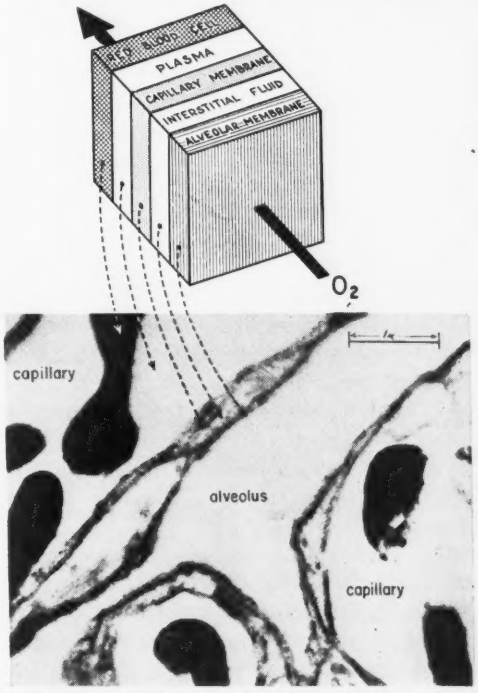

Figure 2.—Electron microscope photograph of rat lung. The photograph (x20,000) illustrates clearly the tissues through which oxygen must pass from the gas phase in the alveolus until it combines with hemoglobin within the red blood cell. No attempt has been made in the schema to portray relative thickness of the different tissues. (Photograph from Low, F. N., Anat. Rec. 117:241, 1953, which appears as Figure 29 in "The Lung" by Julius H. Comroe, Jr., Year Book Publishers, Inc., Chicago, Ill. Reprinted with the permission of the author and the publisher.)

Respiratory Center

While the anatomical location of the respiratory center is generally thought to be in the medulla, yet no definite proof exists.

There are, however two accessory chemoreceptors that act as respiratory centers under certain conditions.

These chemoreceptors are located respectively on the arch of the aorta and at the bifurcation of the carotids.

They are known as the aortic and carotid bodies—and when the respiratory center has become dulled by too much CO_2 and a consequent decrease in O_2, this decreased O_2 stimulates respiration by its action on these chemoreceptors.

The use of O_2 in respiratory acidosis must be carefully supervised.

Pulmonary Capillary Blood Flow

The third factor in *normal* breathing relates to pulmonary capillary blood flow and it must be:

1. Adequate in volume.
2. Distributed evenly.
3. Not under undue pressure.

Summary of Three Factors

In summarizing the three factors involved in *normal* breathing it becomes evident that:

1. Sufficient volume of gas (air) must reach each alveolus.

2. There must be no impediment of passage of gas from alveolus to pulmonary capillary bed.

3. There must be adequate perfusion of the alveoli, without increased pressure.

Pulmonary function studies are devised to ferret out, if possible, any deviation from normal and assess a quantitative value of such deviation.

Case Reports

Case No. 1.—Mrs. M. S.C., a white, female, age 63, had radical left mastectomy five years ago. Repeated thorough check-ups did not reveal metastases.

The Problem: For the past three years, became progressively worse, marked changes in personality, emotional instability, severe headaches, vomiting and lethargy to the point of falling asleep during a conversation.

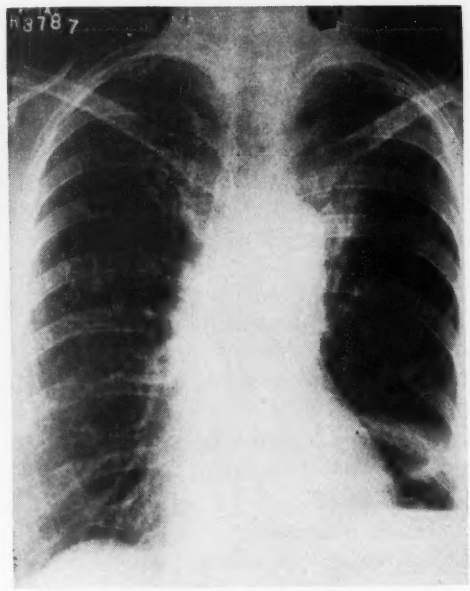

Figure 3.—X-ray of chest, Case No. 1, Mrs. M. S. C.

Examination: Pulmonary function studies showed a marked decrease in all volumes and capacities. Especially apparent was decreased O_2 consumption, which did not improve when placed on pure O_2.

Bronchodilators of no help in increasing volumes or capacities.

Impression: Marked hypoventilation, probably due to excess CO_2 retention and corresponding "dulling" of respiratory center in medulla.

Treatment: Hyperventilation with compressed air by use of Bird, Mark 7. I. P. P. B. valve for twenty minutes.

Immediately following this treatment, a recheck of function studies showed a marked increase in all ventilatory and capacity amounts, together with a normal consumption of O_2 from room air.

Patient has marked decrease of compliance due to mastectomy on left and intensive deep x-ray therapy. This side is practically splinted. Left diaphragm almost completely paralyzed. A stooped kyphotic posture, increasing the A. P., diameter of chest, further contributes to hypoventilation.

Appropriate brace to insure good posture and daily use of I. P. P. B. until good habits of posture and ventilation are established.

Latest follow-up information to the effect patient is doing fine with marked improvement of presenting symptoms.

The thought occurs that this is a more frequent sequela of radical breast surgery than formerly appreciated.

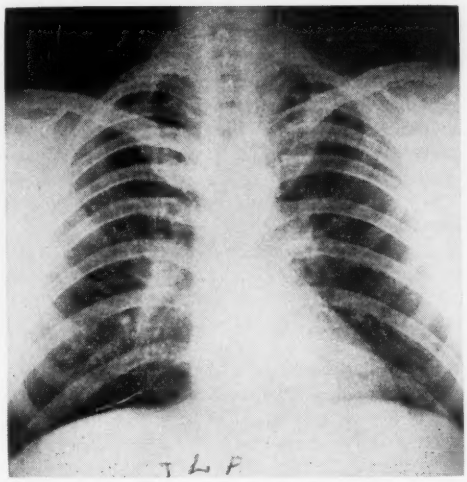

Figure 4.—X-ray of chest, Case No. 2, Mr. J. L. P., April 11, 1959.

Arterial blood studies for CO_2 retention, not available at time of this examination. To be made available in near future.

Case No. 2.—Mr. J. L. P.

Chief Complaint: Cough, expectoration and difficult breathing.

Present Illness: This patient, in great detail, recited a history of onset in 1952 with progressive worsening. He was a painter by trade and stated his condition was better in the fall and during cold weather. He stopped painting in 1956 and drove a moving van all over the country. During this time thought he was better. In 1957 resumed his former trade of painting and shortly thereafter began to cough and have recurrence of difficult breathing. Was told this was an allergic reaction. Had severe emotional strain last year and suffered same symptoms. Has gone to many doctors, had various treatments without marked improvement.

Past history and system review noncontributory.

Physical Examination: Physical examination of chest revealed a few expiratory wheezes which cleared promptly on cough. Breath sounds of good quality and good, equal bilateral expansion. Heart regular in rate and rhythm and no murmurs heard.

TABLE 1
LUNG VOLUMES

NAME: Mr. James L. P.; Sex M, age 40; Weight 187½, Kilograms 82; Height 5' 7¾", Centimeters, 173; B.S.A. 1.96

	APRIL 11, 1959		APRIL 18, 1959	
	Results	Normal Predicted	Results	Normal Predicted
1. Tidal Volume	1050	500 cc	510	500 cc
2. Minute Volume	14.700	5500-7000	6630	5500-7000
3. Alveolar Ventilation	12.600	3800-4900	4680	3800-4900
4. Inspiratory Reserve	2040		2700	
5. Expiratory Reserve	420		750	
		4.85 Collins		Collins
6. VITAL CAPACITY	3.690	3.90 Baldwin	3.96	Baldwin
7. Respiratory Rate	14	11-14/min	13	11-14/min
8. Oxygen Consumption	300	300 cc	300	300 cc
9. M. B. C. Rate	52	40-70/min	48	40-70/min
10. M. B. C.	108,000	130,000	105,600	
11. TIMED				
1st Second	3030	83% of V. C.		83% of V. C.
2nd Second	3360	94% of V. C.		94% of V. C.
3rd Second	3.410	97% of V. C.		97% of V. C.
12. Residual Volume	1066			25% of T. L. C.
13. Functional Residual C.	1486			
14. Total Lung Capacity	4756			
15. RV/T. L. C.	23%			
16. Cal/M^2/Hr.				
17. B. M. R.				
GAS ANALYSIS				
18. O_2 Expired Air	14.5	15.4%	15.1	15.4%
19. CO_2 Expired Air	3.5	5.6%	4.7	5.6%
Dead Space of Machine				

All tests made in the sitting position.

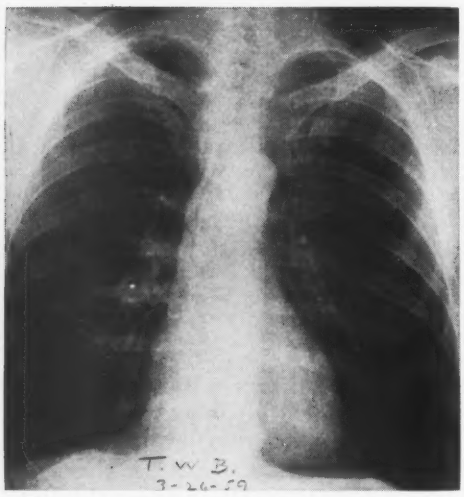

Figure 5.—X-ray of chest, Case No. 3, Mr. T. W. B., March 26, 1959.

X-ray of chest disclosed no abnormality.

Fluoroscopic examination revealed equal bilateral expansion with full, free excursions of both leaves of diaphragm.

Pulmonary Function Studies revealed marked hyperventilation with no other significant findings. (Table 1)

He was placed on compazine spansules 10 mg. a.m. and p.m. for one week, and a recheck of function showed it had returned to a normal status. Stated he felt fine and had no complaint.

Conclusion: Hyperventilation due to emotional instability.

Case No. 3.—Mr. T. W. B. This patient referred by Welfare for confirmation of diagnosis made by x-ray of grade IV emphysema. The only data at hand was statement by patient that he was markedly short of breath.

Lung function studies (Table 2) disclosed an entirely normal ventilatory function and fluoroscopy revealed free and full excursions of both leaves of the diaphragm.

Conclusion: X-ray alone (Figure 5) not always reliable in diagnosing emphysema.

Case No. 4.—Mrs. E. B. M.

Chief Complaint: Chronic cough for many years. Shortness of breath.

Present Illness: The pertinent facts of this history are those of chronic bronchitis over many

TABLE 2
LUNG VOLUMES

Name: Mr. T. W. B.; Sex M, age 58; Date 4/9/59; Weight 143¾, Kilograms 64; Height 5' 9", Centimeters 175; B.S.A. 1.82

	Results	Normal Predicted	Per Cent of Normal
1. Tidal Volume	480	500 cc	
2. Minute Volume	7680	5500-7000	
3. Alveolar Ventilation	5600	3800-4900	
4. Inspiratory Reserve	2370		
5. Expiratory Reserve	1590		
		4.45 Collins	
6. VITAL CAPACITY	4.440	3.79 Baldwin	Normal
7. Respiratory Rate	16	11-14/min	
8. Oxygen Consumption	270	300 cc	
9. M. B. C. Rate	69	40-70/min	
10. M. B. C.	74,700	108,000	69
11. TIMED		4180	
1st Second	3300	83% of V. C.	79%
2nd Second	3940	94% of V. C.	94%
3rd Second	4180	97% of V. C.	100%
12. Residual Volume	1610		
13. Functional Residual C.	3200		
14. Total Lung Capacity	6050		
15. RV/T. L. C.	27%		
16. Cal/M^2/Hr.	42		
17. B. M. R.	Plus 2		
GAS ANALYSIS			
18. O_2 Expired Air	15.4	15.4%	
19. CO_2 Expired Air	4.5	5.6%	
Dead Space of Machine	5400		
All tests made in the sitting position.	Sitting position—Godart Machine		

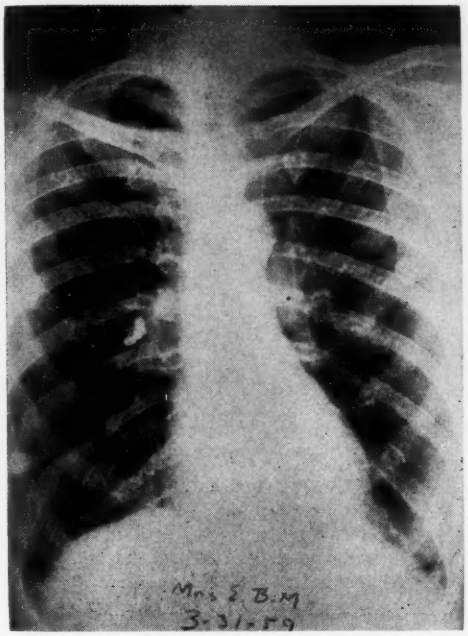

Figure 6.—X-ray of chest, Case No. 4, Mrs. E. B. M., March 31, 1959.

years, with progressive shortness of breath. At the time of examination this latter symptom was embarrassing to the point of interfering with her occupation.

Past History and system review noncontributory.

Physical Examination: Chest revealed numerous moderately coarse and "bubbling" rales throughout both lungs. Upon voluntary coughing, showers of these rales were heard and sputum was raised easily. Heart normal in rate and rhythm and no murmurs heard.

X-ray of chest (Figure 6) revealed fairly normal lung fields with heart and mediastinal shadows within normal limits and position.

Fluoroscopic findings showed sluggish action of both leaves of the diaphragm.

Pulmonary Function Studies (Table 4) were significant with regard to low tidal volume, marked decrease in vital capacity as well as maximum breathing capacity. Timed vital capacity within normal limits. Reserve volume with relation to total lung capacity greatly increased. An immediate response was obtained by use of intermittent positive pressure breathing using Vaponefrin and Alevaire—as shown by a recheck of function at that time.

Conclusion: While this case cannot be classi-

TABLE 4
LUNG VOLUMES
NAME: Mrs. E. B. M.; Sex F, age 62; Weight 113, Kilograms 52; Height 5' 3", Centimeters 161; B.S.A. 1.52

	MARCH 31, 1959		APRIL 13, 1959	
	Results	Normal Predicted	Results	Normal Predicted
1. Tidal Volume	390	500 cc	450	500 cc
2. Minute Volume	8190	5500-7000	9450	5500-7000
3. Alveolar Ventilation	5040	3800-4900	6300	3800-4900
4. Inspiratory Reserve	1020		1350	
5. Expiratory Reserve	150		420	
		2.95 Collins		2.95 Collins
6. VITAL CAPACITY	1.560	2.49 Baldwins	2.220	2.49 Baldwins
7. Respiratory Rate	21	11-14/min	21	11-14/min
8. Oxygen Consumption	240	300 cc	270	300 cc
9. M. B. C. Rate	48	40-70/min	60	40-70/min
10. M. B. C.	15,600	64,000	30,600	64,000
11. TIMED				
1st Second	750	83% of V. C.	870	83% of V. C.
2nd Second	1050	94% of V. C.	1260	94% of V. C.
3rd Second	1260	97% of V. C.	1470	97% of V. C.
12. Residual Volume	2945	25% of T. L. C.	2380	25% of T. L. C.
13. Functional Residual C.	3095		2800	
14. Total Lung Capacity	4506		4600	
15. RV/T. L. C.	65%		52%	
16. Cal/M^2/Hr.				
17. B. M. R.				
GAS ANALYSIS				
18. O_2 Expired Air	15.9	15.4%	15.9	15.4%
19. CO_2 Expired Air	5.	5.6%	5.	5.6%
Dead Space of Machine				

All tests made in the sitting position.

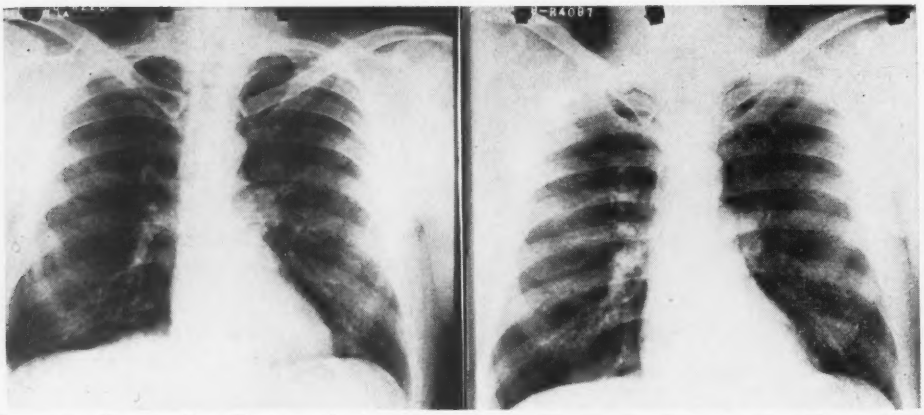

Figure 7.—Comparative films on chest of Case No. 5, W. W. E., January 18, 1955, and March 30, 1959.

fied as a true emphysema, certainly it must be recognized as a pre-emphysemic state. It is generally recognized that chronic bronchitis—over a long period of years—almost inevitably leads to true emphysema with loss of elasticity of the alveolar walls, rupture of alveolar walls and loss of pulmonary capillary circulation.

This condition was readily reversible when patient was placed on appropriate therapy of I. P. P. B.—antibiotics etc. as shown by recheck of function some ten to twelve days later.

Case No. 5.—Mr. W. W. E. This patient was

TABLE 5
LUNG VOLUMES

NAME: Mr. W. W. E.; Sex M, age 47; Weight 145, Kilograms 66; Height 5' 7", Centimeters 170; B.S.A. 1.78

	MARCH 30, 1959		APRIL 17, 1959	
	Results	Normal Predicted	Results	Normal Predicted
1. Tidal Volume	450	500 cc	510	500 cc
2. Minute Volume	7200	5500-7000	6630	5500-7000
3. Alveolar Ventilation	4800	3800-4900	4680	3800-4900
4. Inspiratory Reserve	570		960	
5. Expiratory Reserve	300		360	
		4.40 Collins		4.40 Collins
6. VITAL CAPACITY	1.320	3.83 Baldwin	1.830	3.83 Baldwin
7. Respiratory Rate	16	11-14/min	13	11-14/min
8. Oxygen Consumption	240-270	300 cc	300	300 cc
9. M. B. C. Rate		40-70/min		40-70/min
10. M. B. C.	10,800	109,000	15,600	109,000
11. TIMED				
1st Second	450	83% of V. C.	420	83% of V. C.
2nd Second	720	94% of V. C.	600	94% of V. C.
3rd Second	930	97% of V. C.	750	97% of V. C.
12. Residual Volume				25% of T. L. C.
13. Functional Residual C.				
14. Total Lung Capacity				
15. RV/T. L. C.				
16. Cal/M^2/Hr.				
17. B. M. R.				
GAS ANALYSIS				
18. O_2 Expired Air	17.4	15.4%	17.4	15.4%
19. CO_2 Expired Air	5.6	5.6%	5.6 to 7	5.6%
Dead Space of Machine				

All tests made in the sitting position.

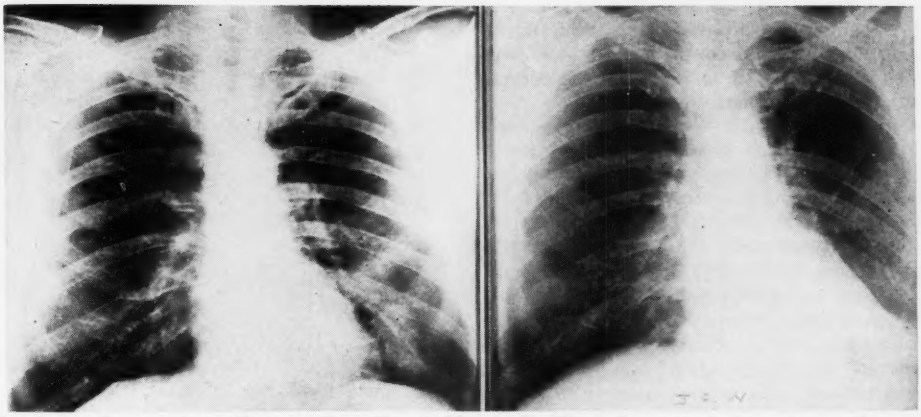

Figure 8.—Comparative films on Case No. 6, Mr. J. F. W., before surgical resection, January 9, 1959, and after, April 16, 1959.

diagnosed as chronic obstructive emphysema grade IV by me in 1955. At that time no function studies were done, nor did I have a definite, clear-cut approach to treatment.

Upon his readmission to the Gilmer Hospital on March 30, 1959, lung function studies were done which are shown on the chart. (Table 5)

He was placed on an intensive treatment of alevaire inhalation, together with I. P. P. B. employing broncho-dilators, and appropriate antibiotics. His response has been good as shown by the comparative lung function studies. (Table 5)

TABLE 6
LUNG VOLUMES

NAME: Mr. J. F. W.; Sex M, age 63; Weight 165, Kilograms 75; Height 5' 11", Centimeters 180; B.S.A. 1.94

	JANUARY 10, 1959		APRIL 16, 1959	
	Results	Normal Predicted	Results	Normal Predicted
1. Tidal Volume	1290	500 cc	990	500 cc
2. Minute Volume	29.850	5500-7000	14.850	5500-7000
3. Alveolar Ventilation	17.100	3800-4900	12.600	3800-4900
4. Inspiratory Reserve	2580		1740	
5. Expiratory Reserve	900		1170	
		4.85 Collins		4.85 Collins
6. VITAL CAPACITY	4.770	4.02 Baldwin	3900	4.02 Baldwin
7. Respiratory Rate	15	11-14/min	15	11-14/min
8. Oxygen Consumption	330	300 cc	330	300 cc
9. M. B. C. Rate	45	40-70/min	40	40-70/min
10. M. B. C.	85,500	105,000	66,000	105,000
11. TIMED				
1st Second	3030	83% of V. C.	2370	83% of V. C.
2nd Second	3840	94% of V. C.	2880	94% of V. C.
3rd Second	4140	97% of V. C.	3180	97% of V. C.
12. Residual Volume	1635		1448	25% of T. L. C.
13. Functional Residual C.	2535		2618	
14. Total Lung Capacity	6405		5348	
15. RV/T. L. C.	26%		27%	
16. Cal/M^2/Hr.	48			
17. B. M. R.	Plus 35			
GAS ANALYSIS				
18. O_2 Expired Air	16.9	15.4%	15.5	15.4%
19. CO_2 Expired Air	3.7	5.6%	4.4	5.6%
Dead Space of Machine				

All tests made in the sitting position.

Case No. 6.—Mr. J. F. W. This patient was sent for pulmonary function studies for evaluation in contemplated lung surgery. A lesion was present in the left lung, and although not proven, it was judged to be carcinoma. He had previously been treated for active pulmonary tuberculosis in the left lung and had been on an inactive status several years.

Overall function was considered good as reflected by adequate vital capacity, maximum breathing capacity and timed vital capacity. His reserve volume with relation to his total lung capacity was well within normal limits.

The excessively increased minute volume was attributed to uneven ventilation. In other words, in order to satisfy his oxygen need he had to exchange larger than normal amounts of gas—much of which entered aveoli having poor or no vascularity and other portions of the gas going to poorly ventilated alveoli with good vascularity. By surgical excision of this area, his minute volume should decrease.

Comparative studies made since surgery (lobectomy) reflected the improvement anticipated. His overall function was better and the work of breathing reduced. The lesion proved to be primary, bronchogenic carcinoma, squamous type.

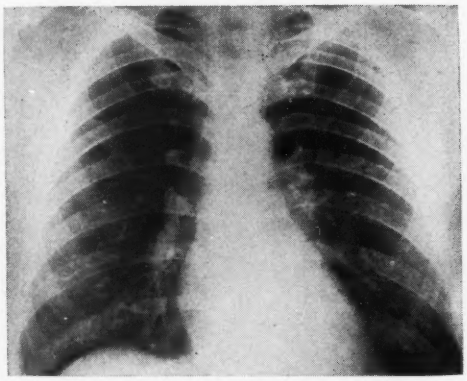

Figure 9.—X-ray of chest, Case No. 7, Mr. R. W. B.

Case No. 7.—Mr. R. B. This was an industrial problem. This 39 year old white man was exposed to the fumes of anhydrous ammonia over a rather long period of time. A pipe carrying the chemical broke and his clothes were saturated with ammonia. The fumes had an immediate corrosive

TABLE 7
LUNG VOLUMES

NAME: Mr. R. B.; Sex M, age 39; Date 2/12/59; Weight 181½, Kilograms 83; Height 6', Centimeters 175; B.S.A. 2.04

	Results	Normal Predicted	Per Cent of Normal
1. Tidal Volume	450	500 cc	90%
2. Minute Volume	8550	5500-7000	
3. Alveolar Ventilation	5700	3800-4900	
4. Inspiratory Reserve	3360		
5. Expiratory Reserve	600		
		4.95 Collins	
6. VITAL CAPACITY	4.410	4.12 Balwins	97%
7. Respiratory Rate	19-20	11-14/min	
8. Oxygen Consumption	270	300 cc	90%
9. M. B. C. Rate		40-70/min	
10. M. B. C.	108,000	136,000	80%
11. TIMED			
1st Second	3450	83% of V. C.	78%
2nd Second	4050	94% of V. C.	92%
3rd Second		97% of V. C.	
12. Residual Volume	3154		
13. Functional Residual C.	3754		
14. Total Lung Capacity	7.564		
15. RV/T. L. C.	39+%		
16. Cal/M^2/Hr.	38		
17. B. M. R.	0		
GAS ANALYSIS			
18. O_2 Expired Air	16.1	15.4%	
19. CO_2 Expired Air	4.9	5.6	
Dead Space of Machine			

All tests made in the sitting position.

effect on the mucous membrane of the oral, pharyngeal and laryngeal cavities. He experienced marked edema of the larynx and felt as though he were choking. Emergency measures brought temporary relief and several days later sloughing of the affected membranes occurred.

He resumed work and apparently was all right until some six weeks later when intractible dry cough and fever developed. He was hospitalized and given various antibiotics and gradually symptoms disappeared. During this attack he complained of a burning sensation in both lungs—and was told he had rales in his chest.

Patient was sent in for pulmonary function studies and evaluation of disability, if such was found.

Physical examination of the chest revealed good and equal bilateral expansion. The breath sounds were clear and no rales were heard. Fluoroscopic examination showed normal excursions of the diaphragms and good illumination of both lungs.

Pulmonary Function studies revealed good overall function as shown by normal Vital Capacity, normal Maximum Breathing Capacity, as well as Timed Vital Capacity. The Residual Volume is within normal limits. There is some evidence of uneven distribution as shown by increased Minute Volume. (Table 7)

Comment: The tissues of the upper respiratory tract responded characteristically and promptly to the insult of the irritant gas. There being considerable moisture at these sites ammonium hydroxide was formed immediately and exerted its corrosive effect. Apparently no permanent damage done here.

As the gas passed down the tracheo-bronchial tree and into the terminal bronchioles and alveoli, it was less concentrated and the area less moist than in the upper respiratory tract.

The reaction here was less severe and did not manifest itself for some time after the exposure. Its presence became evident with the attack of coughing, burning etc. which caused the patient to again seek medical treatment.

Conclusion: As far as can be detected at this time, no damage of significant extent can be demonstrated as a result of this exposure.

Case No. 8.—Mr. T. L., age 71, white male. Left pneumonectomy for squamous cell carcinoma performed June 1953.

Here again no problem is present. The patient is comfortable and enjoying life compatible with his age. Although a lung may become hyperinflated in a compensatory manner, yet this fact per se does not necessarily indicate pulmonary insufficiency.

Pulmonary function studies on the remaining "hyperinflated" right lung are given in Table 8.

In comparing these values with the predicted values for both lungs, it becomes readily apparent that the right lung alone is performing adequately as to ventilation, capacities and O_2 consumption.

It has been held in the past that a hyperinflated lung was lacking in actual function—i.e.—normal exchange of O_2 and CO_2 as well as deficiencies in ventilation. This case is cited merely to refute the old concept.

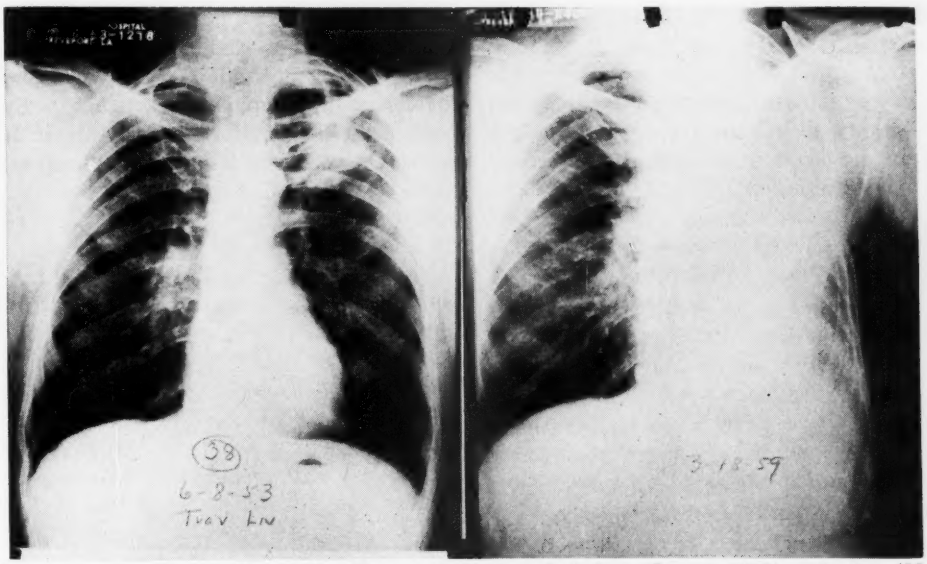

Figure 10.—Case No. 8, Mr. T. L. X-rays of chest made before (June 8, 1953) and after (March 18, 1959) left pneumonectomy for squamous cell carcinoma.

TABLE 8
LUNG VOLUMES

NAME: Mr. T. L.; Sex M, age 71

	Results	Normal Predicted
1. Tidal Volume	510	500 cc
2. Minute Volume		5500-7000
3. Alveolar Ventilation		3800-4900
4. Inspiratory Reserve	810	
5. Expiratory Reserve	210	
6. VITAL CAPACITY	1.530	Collins Baldwin
7. Respiratory Rate		11-14/min
8. Oxygen Consumption		300 cc
9. M. B. C. Rate		40-70/min
10. M. B. C.	2610	
11. TIMED		
1st Second	640	83% of V. C.
2nd Second	300	94% of V. C.
3rd Second	90	97% of V. C.
12. Residual Volume		25% of T. L. C.
13. Functional Residual C.		
14. Total Lung Capacity		
15. RV/T. L. C.		
16. Cal/M^2/Hr.		
17. B. M. R.		
GAS ANALYSIS		
18. O_2 Expired Air		15.4%
19. CO_2 Expired Air		5.6%
Dead Space of Machine		

All tests made in the sitting position. Complete studies not done.

Summary and Conclusions

A brief outline of the principles of pulmonary physiology has been presented. No attempt has been made in this presentation to explore the more complicated and highly technical fields of blood-gas exchanges, specific diffusion studies or partial pressures of CO_2 and O_2.

This paper is presented with the thought of stimulating more interest in this important field and to show that many of the simpler tests may be performed in the physicians office with rewarding information. With this in mind the above series of cases was chosen.

Diagnosis and Management of Cor Pulmonale*

• In cor pulmonale there are many definitions, sometimes few symptoms, and all aids may have to be used in diagnosis. Response to therapy is in proportion to the reversibility of the underlying physiological causes.

JAMES W. WADE III, M. D.
CYRIL T. YANCEY, M. D.
Monroe

THE literature abounds with different interpretations of cor pulmonale. Dr. Paul White apparently introduced the term in 1931, but interchangeably used "emphysema heart". Approximately twenty-six years later Fishman and Richards defined cor pulmonale as "a heart which manifests dilatation, hypertrophy, or failure secondary to intrinsic diseases of the lung". A short time later George G. Griffith elaborated on the above and subdivided the term into two groups:

A. Primary cor pulmonale—pulmonary hypertension as the basic lesion.

B. Secondary cor pulmonale—due to lesions of the left side of the heart.[7]

The basic factor in the above, however, is pulmonary hypertension regardless of the etiology. When systemic hypoxia is present its myocardial depressing effects add further to this physiological derangement. It would appear that cor pulmonale should be a descriptive term reserved for cases of right ventricular hypertrophy and failure, compensated or decompensated, due to changes in the pulmonary vascular bed. If the pulmonary vascular resistance is increased the cardiac output will decrease and if there is a decrease in the arterial oxygen saturation, there will be an increased demand on the cardiac output. Varying degrees of these factors are present in chronic lung disease and they probably work against each other. The net effects of these two forces is hard to evaluate experimentally at the present time. For those who wish to differ, one component is usually intimated in all unrelated definitions of cor pulmonale. There is a primary or secondary change in the pulmonary vascular bed.

Physical Findings

A paucity of physical findings may be present in cor pulmonale depending upon the degree of cardiac compensation, however they usually consist of malaise, apprehension, dyspnea, fatigability, anorexia and weight loss. Cyanośis and clubbing of the fingers may be present when the condition has been of long duration. The heart may be normal to percussion, nevertheless one should be suspicious of a shifting P.M.I. toward the xiphoid on inspection. Tachycardia may be present and systolic and diastolic murmurs along the left border of the sternum are common. The pulmonary second sound is usually accentuated. Overt signs of right sided decompensation may be present in advanced cases.

Any controversies related to the presence of cor pulmonale may be settled by cardiac catheterization but this is still impractical in the average hospital or physician's office. Simple, valuable procedures may be easily obtained however. They consist of circulation time studies, venous pressure with hepatojugular reflux and the hematocrit. A careful history and physical examination still re-

* Presented at the Seventy-ninth Annual Meeting of the Louisiana State Medical Society, in New Orleans, May 5, 1959.

main the most important factors in the diagnosis of this condition.

Roentgen Findings

Roentgenologically the heart may or may not appear enlarged. Quite commonly there is a prominence of the pulmonary artery segment along the left cardiac border, causing a convexity of this area instead of the concavity usually found. Bronchovascular markings may be exaggerated due to engorgement of the main pulmonary arteries and their chief subdivisions.

Enlargement of the right ventricle may be demonstrated in the right anterior oblique view in which the right ventricle forms the anterior border of the cardiac silhouette and encroaches on the retrosternal space. In many cases there may be coexisting enlargement of the left ventricle. This may be due to existing anoxemia or to independent cardiac diseases. One should be careful however in the interpretation of left ventricular enlargement because right ventricular hypertrophy may produce marked clockwise rotation of the heart. The left ventricle may then fluoroscopically appear falsely enlarged. In severe decompensated cor pulmonale widening of the entire transverse cardiac silhouette may be seen. This is often due to right atrial enlargement. In these cases the shadow of the superior vena cava may also be wide and prominent.

Electrocardiographic Findings

Electrocardiographic changes in cor pulmonale are usually manifestations of positional cardiac changes. This may be secondary to diaphragmatic descent with changes in the lung size and volumes or to primary cardiac enlargement. Distinct evidence of right ventricular hypertrophy is usually observed only in advanced cases.

Electrocardiograms may disclose no abnormalities, however occasionally the ECG may be of some aid. The most definite evidence of right ventricular hypertrophy is a reversal of the QRS pattern in the precardial leads. V-1 through V-4 exhibit tall R-waves with relatively small S-waves. The T-waves may be inverted in V-1 through V-4 and upright in V-5 through V-6. T-waves may be inverted in all precardial leads due to associated left ventricular disease. Precardial leads from the right side of the chest may further elucidate right ventricular hypertrophy. Standard limb leads may exhibit right axis deviation but this is a nonspecific sign dependent on the position of the heart. Tall sharply spiked P-waves (P-Pulmonale) are often seen in the standard leads II, III, AVF. They probably reflect right auricular hypertrophy or dilatation. These findings are only confirmatory evidence but since they occur frequently in cor pulmonale they must be regarded as an important concept in this disease.

Physiological Causes

Response of cor pulmonale to therapy is directly proportional to the reversibility of the underlying physiological causes. This stresses the need for early diagnosis before the underlying pulmonary changes become static, and is especially true in pulmonary emphysema. Commonly the first attack of cor pulmonale is preceded by an acute bronchitis or pneumonitis. Infection leads to mucosal edema with an increase in bronchial secretions and exudates. Alveolar hypoventilation and bronchospasm result. Under the above conditions the energies expended to maintain adequate pulmonary ventilation become tremendous.

This becomes clear when one keeps in mind that resistance to airflow in a channel varies inversely to the fourth power of the channel diameter. If the diameter of the bronchial tree is reduced to one half of its original size by the infection, the resistance will be increased by a numerical factor of 16.[16] Since work and resistance are directly proportional, the energy expended to maintain ventilation becomes enormous. The heart and thoracic musculature must therefore increase their work despite an existing oxygen deficit. Fever, superimposed on

the body's inflammatory response, increases the tissues' metabolic demand for oxygen and contributes further to the already existing hypoxia. In an attempt to reduce the elevated body temperature there is dilatation of the skin subpapillary venous plexuses. This places an additional demand on the cardiac output. A vicious cycle is then established which perpetuates itself.

A crucial point in the individual's survival may be whether the maximum energy that can be expended under the above circumstances can support adequate pulmonary ventilation. This demonstrates why treatment of bronchopulmonary infections is one of the most important available means for the prevention of cor pulmonale. It is important to recognize the presence of infection before the heart failure develops. Any acute or unexplained exacerbation of malaise, cyonosis, dyspnea, cough or wheezing in a patient with chronic lung disease should make one suspect the presence of pulmonary infection. It should be remembered that bronchial secretions may contain a large bacterial flora without being obviously purulent. This is because the fibrin structure of the dying mucus prevents leucocytic migration into it. For this reason a gram stain and culture of the sputum are important.

Therapy

One should not wait for the full blown picture of the infection to develop before starting treatment and it should be borne in mind that fever may be supressed if the patient is on corticoids. Therapy employing the combined use of antibiotics appears advantageous. It usually consists of penicillin and one of the broad spectrum preparations such as the tetracyclines. Unilateral bronchopulmonary infections in the presence of widespread lung disease can possibly lead to a generalized pulmonary hypertension. It has been shown that hypoxia causes pulmonary artery vasoconstriction. Experimentally if unilateral hypoxia is established there is an increase in the quantity of blood shunted to the eupoxia side. Pulmonary hypertension may then result.

Bronchodilators are of help in the treatment of bronchospasm, bronchial obstruction, and in the reduction of bronchial secretions. The bronchodilators may be classified roughly in two groups: the direct bronchodilators and the systemic bronchodilators. The oral preparations are somewhat disappointing; the reason for this most likely lies in the fact that the generalized systemic effect may be disadvantageous to the patient and thus limit the benefit that they produce. One usually cannot get the maximum desired effect without other systemic side effects ranging from tachycardia to dryness of the mouth. These compounds are therefore useful as basic medications given in smaller quantities than their full dosage. Aminophyllin is a very useful drug because it is a coronary vasodilator, cardiac stimulant, bronchodilator, and it induces or increases diuresis. It has been reported that the drug also acts synergistically with ephedrine. Its use as a suppository should be reserved for acute exacerbations because it tends to cause a granular proctitis.

One of the most effective ways to employ the dilating effect of the epinephrine like drugs is direct application to the bronchial mucosa by use of a hand nebulizer or by the use of intermittent positive pressure breathing. Even in the presence of systemic hypertension epinephrine-like drugs are relatively safe because systemic absorption is somewhat limited. Intermittent positive pressure breathing appears to afford more relief than the bronchodilators alone. This is probably related to its direct physical effect on the pulmonary physiology.

In the presence of bronchial inflammation any anti-inflammatory substance may act indirectly as a bronchodilator. Therefore there is a real use for corticoid therapy in inflammatory conditions of the bronchi; however, one must be careful "to cover" the patient with adequate antibiotics. Pulmonary tuberculosis must also be ruled out before one embarks on

prolonged corticosteroid therapy. Fortunately, the dosage required to produce improvement in these patients is a little more than the normal output from the adrenal glands. As a rule after the initial loading dose only a small fraction of this amount is required in the morning to reduce the sputum considerably and increase the expiratory vital capacity. Clinically it appears that there is no advantage in using ACTH Jel in place of oral corticoids.

Sputum liquefying agents such as ammonium chloride and the iodides are many times disappointing. Again the problem arises that a very large dose is necessary for any considerable bronchorrhea to be produced. With iodized drugs the effective dose for an individual may be that amount which will produce mild soreness of the mouth and also loss of taste and smell. Ammonium chloride in adequate doses may further upset the patient's acid balance state which is already deranged in the presence of chronic lung disease with superimposed infection and hypoxia. By far the most useful liquefying agent is water, both by mouth and inhalation, the latter in the form of steam.

The routine use of enzymes such as Trypsin or Desoxyrabonuclease appears to have varying degrees of side effects. Frequently, hypersensitivity to these enzymes may be observed. It is thought that Trypsin may produce an undesirable change in the bronchial mucosa. When the mucosa is suffering the assaults of a disease process great care must be taken not to create further injury.

The antihistamines may exert some effect in reducing inflammation and bronchospasm associated with chronic pulmonary infections. Many clinicians feel, however, that they cause a drying of mucous membranes with inspissation of mucus plugs.

Diamox has been recommended in the treatment of cor pulmonale because of the following pharmacological effects. It causes a copious renal excretion of sodium, potassium, bicarbonate, and water. This diuresis reduces pulmonary and venous congestion. It may also reduce the hypercapnea and its associated depression of the respiratory center. To be effective Diamox must be given in large doses for four to five days with free rest periods of two to three days. The drug frequently is disappointing and after an initial improvement of several weeks the symptoms usually return whether the drug is continued or not.

Recently it has been demonstrated that salicylates in large doses increase the sensitivity of the respiratory center to carbon dioxide. It seems however that very large doses out of the range of tolerance are required. The use of salicylates for this purpose is still in the experimental state.

Chronic hypoxia in emphysema leads to hypervolemia with increased circulating blood volume and polycythemia with an increase in the hematocrit and viscosity. The circulatory effects may be beneficial in the early stages since they compensate for the reduced oxygenation of the alveolarcapillary blood. "It is clear that the oxygen carrying capacity is almost the same in the case of blood only 70 to 75 per cent saturated with oxygen in a concentration of 20 grams of hemoglobin per 100 ml. as it would be in a normal concentration of 16 grams of hemoglobin per 100 ml. 96 per cent saturated.[4]" In the same manner it can be shown that an increased cardiac output compensates also for a decreased supply of oxygen. When polycythemia becomes marked however it may have a deleterious and overloading effect on the heart in increasing still more the cardiac work. Phlebotomy in such cases may be of considerable benefit by breaking this vicious cycle and reducing the hypervolemia, polycythemia and blood viscosity. Phlebotomy should be performed if the hematocrit is elevated to 50 or more. Occasionally re-evaluation and "tidying" up the patient's therapeutic regime may gradually reduce the polycythemia without necessitating phlebotomy, provided the patient is not in acute distress. An

attempt should be made to maintain the hematocrit between 45 and 50. Isotopes may be used to reduce the polycythemia. Caution should be in order in the use of phlebotomy and diuretics. If there is a very high hematocrit it is important to do a phlebotomy before administering the diuretics in order to prevent excessive blood hemoconcentration and increase viscosity.

In advanced pulmonary disease the respiratory center in the medulla becomes proportionately insensitive to the rising CO_2 blood concentrations. A physiological level is then reached at which the patient depends on chemoreceptors located in the carotid and aortic bodies. These trigger areas are sensitive to circulatory arterial hypoxia which under the existing circumstances becomes the dominant respiratory stimulus. If these patients are given oxygen in high concentrations there may be a decrease in the existing arterial hypoxia and this vital respiratory stimulus disappears. The existing hypoventilation becomes aggravated. There is an increase in the manifest hypercapnea and respiratory acidosis is augmented. Narcosis, coma and death may then ensue. Oxygen therapy may be hazardous and should be given under close supervision when first administered. This may be done by giving low concentrations of 20 to 40 per cent oxygen, or more concentrated oxygen may be given intermittently depending upon the patient's clinical response.

Cardiotonic drugs in acute and decompensated cor pulmonale may be of secondary importance, since the usual underlying causative or responsible factors are alveolar hypoventilation and pulmonary hypertension. Digitalis therapy should be instituted slowly and cautiously. The results are frequently not so clinically gratifying as are seen in left ventricular failure and may be masked by the beneficial results of antibiotics and bronchodilators. Diuretics and salt restriction are also of importance in these cases.

Sedatives in a hypoxic disorientated patient tax the physician's pharmacologic knowledge. It is easy to see why a drug which exerts respiratory center depression and smooth muscle spasm is detrimental. The worst offenders in this group are the opiates and barbiturates in large doses. Chloral hydrate is usually therapeutically effective and is the drug of choice by many physicians. Tranquilizers are of use at times but may further add to the patient's sensorial cloudiness.

Summary

Alveolar hypoventilation and pulmonary hypertension are major pathological components leading to polycythemia, hypervolemia, myocardial hypoxia and altered right ventricular dynamics, compensated or decompensated. The physiological result is collectively designated as cor pulmonale. Therapy is aimed primarily at the pulmonary vasculoparenchymal dysfunction and secondarily at the failing right ventricle.

Antibiotics of choice usually consist of one of the broad spectrum derivatives combined with penicillin. Sputum cultures and sensitivities enhance drug specificity.

Oxygen, corticoids, and bronchodilators form an equally important background in this therapeutic regime.

Sputum liquefiers and Diamox are of limited value.

Overt heart failure is treated by slow digitalization, sodium restriction and diuretics.

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Historical Notes

Man (**genus homo**), has by common consent been placed by the naturalists at the head of the animal kingdom, and although he has the means of protecting himself to a great extent, by clothing, fire, and houses, from extremes of heat and cold, he cannot abstract himself wholly from those climatic influences which modify the species of other genera. * * *

It is curious to see the perfect parallel which the genus **Canis** (Dog) runs with that of Man. The dawn of history finds the uttermost parts of the earth covered with different races of men, and everywhere these human types have been associated with one or more races of dogs equally distinct from each other.

It is now demonstrated from the monuments of Nineveh and Egypt that the races of the genus **homo**, and those of the familly of the Canidoe (Dogs) were as distinct in type 3500 years ago as they now are, and that no causes in operation from that date to the present have been able to change one form into another.

J. C. Nott: Instincts of Races,
New Orleans M. & S. J. 19:1 (July) 1866.

A Simple Practical Method For Increasing Accuracy of Protein Bound Iodine Determination

• Solution for common hazard is described for a valuable diagnostic test.

F. MICHAEL SMITH, JR., M. D.
JOHN N. FRAZER, M. T.
Thibodaux

THE diagnostic value of the protein bound iodine level has become a most important fixture in the practice of modern medicine. Current procedures are based on the distillation of iodine from an acid digestion of proteins. In this manner very minute amounts of iodine, about one ten-millionth of a gram per each milliliter of sera, are measured. Contamination by mercury or extraneous iodine is a very serious hazard.

When we first set up the P.B.I. test at this Clinic, we experienced several months of repeated disappointments and frustrations. We attempted to make our own reagents and underwent repeated failures until Mr. Frazer, our head technologist, started using demineralized water. Because of our experience, we urged Mr. Frazer to prepare the following report; which we feel will be a guide to others who are setting up the P.B.I. test or who are having trouble with the test in any manner.

The determination of the protein bound iodine blood level requires absolutely accurate and reliable reagents. The purchase of a complete reagent set and a distillation apparatus can still present a very serious problem. In our case, the reagent blank changed daily and, at times, threatened to ruin plans for future determinations.

A hint to our solution was found when we gave up distilling our own water and began purchasing distilled water. Here again, to a modified degree, the old problem of the fluctuating blank began to appear in the laboratory. Several commercial sources for the water gave widely differing results. The solution began to emerge when several carboys of water from the same plant were found to differ —simply because some of these were not sealed!

The use of an ion-exchange resin apparatus resulted in chemically pure water, which worked well the day it was made in the laboratory. Each day that passed gave increasing higher values for the reagent blank.

The evident necessity for fresh demineralized water was proved by daily (A) passing distilled water through an ion-exchange demineralizer or (B) passing ordinary raw tap water through the same apparatus two times to give highest purity.

After 100 determinations of protein bound determinations, we have gotten absolutely consistent results of the highest accuracy. In our laboratory, it is part of our procedure that we fill one or two carboys from demineralized raw tap water passed through a fresh ion-exchange bed. Each day protein bound iodine determinations are made, the water from the carboy of demineralized water is passed once again through a fresh ion-exchanger bed as it is used for the test.

The precautions have so simplified and standardized the test, that any laboratory

From The Children's Clinic, Thibodaux, La.

technologist can determine the test with ease and confidence.

Discussion

The U. S. Pharmacopeia states, "demineralized water will be interchangeable for distilled water for pharmaceutical purposes, except those involving the preparation of injecting preparations." This is explained on the basis the ion-exchange bed will not remove bacteria or pyrogens. However, the demineralized water properly prepared will be comparable to triple distillation, which is suitable for critical analytical determinations.

One demineralizer is made by Crystal Research Laboratories, Inc., 29 Allyn St., Hartford 3, Conn. (Deeminizer). Another ion-exchange apparatus is manufactured by the Illinois Water Treatment Company, 840 Cedar St., Rockford, Ill. (Illcoway ionXchange.) These units are not expensive and give economical water.

Natelson [1] recommends distilled water be passed through an ion-exchange apparatus before using as diluent in test and making of standards in flame photometry for sodium and potassium determinations.

A standard chemistry text [2] states, "it is very difficult to keep chemically pure water for any length of time because of the solubility of gases in the atmosphere, especially carbon dioxide." There is also evidence of a solvent action of distilled water on glass containers.

Caraway [3] found distilled water often contaminated with chlorine (also a halogen, as iodine). He advocated routine testing of purity of such water.

Summary

A method for routine preparation and treatment of distilled water and/or raw tap water is described here. This makes possible carefully controlled conditions for protein bound iodine determinations.

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Historical Notes

Why is it that the dog fanciers lay so much stress on **pure blood**? Does not an impure cross destroy the value of a stock and its reliability for breeding purposes? * * * So adhesive is the strain that a mare of Lord Derby that had a colt by a Zebra, when bred afterwards for several successive years to thorough bred horses, had every colt more or less striped like a Zebra, which had been the father of the first colt only. The Greyhound has little sense of smell and pursues his game by sight and speed. The Hound, on the contrary, depends on smell and endurance. The Bulldog is useless for hunting purposes. * * * These qualities are retained so long as the race is kept pure, and when two are crossed, an intermediate type is produced partaking of the physique and moral of both parents.

J. C. Nott: Instincts of Races, New Orleans M. & S. J. 19:5 (July) 1866.

Treatment of Major Compound Injuries of the Hand

• The complexities of the subject are described and the management to bring optimal results.

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New Orleans

THE increase in frequency of compound injuries of the hand has been concomitant with agricultural mechanization and increasing industrialization. These injuries present complex problems of reconstruction of both the surface tissues and the deeper structures. For this discussion a compound injury of the hand is defined as one with significant loss of surface tissue as well as injury to the essential deep structures. Treatment should be initiated only after careful evaluation of the extent of the injury and formulation of a plan of reconstruction including both the primary and later operative stages. Evaluation of injuries of this type requires a combination of preoperative and operative study. The extent of loss of surface tissue and of sensation usually can be determined in the emergency room. Fractures are demonstrated by roentgenography before operation. Motor function in the severely injured hand is frequently difficult to evaluate and final evalation must await examination with use of a general anesthetic. All structures involved in an injury should be carefully examined and evaluated with use of an anesthetic and in a sterile field despite any preoperative impression gained of these structures.[1-3]

Selection of a plan of treatment is of basic importance and involves consideration of many factors. Function and cosmesis must both be considered, although, in general, optimal function produces an optimal cosmetic effect. The needs of the patient must be balanced against his loss in terms of time, money, and discomfort. The tendency, in the past, has been to be overly concerned with the economic loss and insufficiently aware of the advantages of reconstruction. A multi-staged reconstructive program that will materially improve the function of the hand, although irksome to the patient at the time, is usually a sourse of gratification to both patient and surgeon when it is completed.[3] The urge to "finish the job in one operation" is too often present. The value of reconstruction must be emphasized to both the medical profession and the lay public.

A few factors militate against reconstruction beyond a simple short term program. Advanced age, subnormal intelligence, and emotional imbalance precluding cooperation by the patient discourage the surgeon from a complicated reconstructive plan. Loss of minimal function of the hand, e.g., evulsion of the fifth digit, usually does not warrant a long-term program. However, in most injuries of this type, particularly those endangering the basic functions of pinch and grasp, complete reconstruction is well worth-while. Although the component parts of the injury must be treated as a whole, they will be dealt with separately for purposes of discussion.

Immediate Treatment

Surface Tissue—Immediate or early closure of the wound is essential to successful reconstruction of the hand.[4, 5] Healing of wounds of the hand by secondary intention occurs less often now than formerly. A granulating wound with its attendant chronic infection, edema, and deposition of protein in the

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mobile structures of the hand will often lead to stiffening and loss of function of the hand.

It is unusual to encounter a wound of this type within twenty-four hours of injury that cannot be closed immediately. I have routinely applied grafts and flaps to crushed, evulsed or gunshot wounds of the upper extremities with prompt healing without infection. I do not routinely use antibiotic therapy in these cases but this may occasionally be helpful. The principle of delay in closure of a wound that is sometimes expressed seems to be an outgrowth of military surgery. Combat surgery and that done in the modern urban hospitals of this country are not comparable. The differences between the two in the degree of contamination of the wound, delay in transportation, operating conditions and facilities for postoperative care are significant.

Immediate closure of these wounds with primary suture, grafts or flaps is predicated on the proper preparation of the wound.[5] Meticulous debridement requires the utmost patience and considerable experience in recognizing damaged tissue. Unnecessary removal of important structures is particularly damaging in the hand with its intricate mobile mechanisms. However, failure to remove dying tissue or foreign bodies will result in suppuration with its sequelae of fibrosis and stiffening of the hand. Several hours may often be spent in such debridement with gratifying results. The wound should be irrigated with large amounts of physiologic saline solution under moderate pressure before, during and after debridement.

Skin, such as a partially evulsed flap of doubtful viability, should be excised and replaced with a graft or flap as indicated.[5] It is better to excise viable skin than to leave tissue that will ultimately necrose.

The choice of method of closure of the wound is dictated by the type of wound. Closure of the wound with local tissue is, of course, the ideal and should be done when possible. However, if this is impractical, tissue must be obtained from elsewhere. A free graft of full or partial thickness skin is used, if possible, and is indicated if tendons, bones, joints and nerves are not exposed. The necessity for future reconstruction of the deep structures will preclude the use of a free graft.

Exposed tendons, bones, nerves, and joints that cannot be covered by local tissue require pedicle flap coverage. This should be done as the primary procedure in the treatment of these injuries. Exposed tendons, joints and cortical bone are usually insufficiently vascular to accept a free graft. In many instances these structures have themselves been deprived of adequate blood supply, and if nourishment is not furnished, they will undergo necrosis. It has been my experience that these structures, whose blood supply has been reduced to the point of necrosis, may often be preserved both anatomically and functionally by coverage with a vascular pedicle flap. In one of my patients whose hand had been deprived of its soft tissue covering and of vascular supply to the distal two-thirds, preservation of the tendon, bone, joint and nerve complex was possible both anatomically and functionally. It has been apparent that immediate application of pedicle flaps, when indicated, has greatly reduced the period of morbidity, immobility and stiffening of the hand which is so often a sequel of these injuries.

In general, there are only two contraindications to immediate application of a flap: (1) other major injuries with poor general condition of the patient, and (2) such severe contamination of the wound that it cannot be eradicated at the initial procedure.

The source of flap tissue is dictated by the individual injury. If possible, resurfacing should be accomplished by local rotation or transposition flaps. The area that can be covered by a local flap is limited, even on the dorsum of the hand, and underestimation of the size of the pedicle flap required is common among those unaccustomed to dealing

with these problems. Local flaps can usually be moved with impunity in one stage, if they are properly designed, and this constitutes the ideal method of coverage when a pedicle flap is required.

The opposite forearm and arm, abdomen, and chest are potential sources for distant flaps. Cross forearm flaps are of limited size and the necessary position of the extremities is so disabling to the patient that they are usually not used. A pedicle flap of moderate size can be elevated from the opposite arm and this gives the patient greater use of the upper extremity during the period of attachment of the flap. Cross arm flaps are of value in resurfacing the dorsum of the hand and fingers but are difficult to position for coverage of the palmar surface.

Abdominal skin is most widely used and furnishes an almost unlimited source of pedicle flap skin.[3, 5] Except in the obese or aged an abdominal flap may be formed in one stage to cover all or a portion of the dorsum of the hand and digits. Pocket or bi-pedicle abdominal flaps should not be used if it is possible to avoid them. The exposed raw tissue on the flap and in the bed of the flap tend to increase the inflammation, edema, and eventual stiffening of the hand itself. Abdominal skin with its thick panniculus is not an ideal replacement for the skin of the hand but may be the best available.

Pedicle flaps from the anterior wall of the chest create prominent scars and should not be used in women. However, if an abdominal flap is inadvisable, the skin of the chest affords equally good coverage with less subcutaneous fat.

Nerve Repair—The superiority of primary nerve repair over secondary repair has been demonstrated to my satisfaction.[2] All nerves should be repaired primarily if additional dissection is not necessary. Neurorrhaphy requiring advancement and transplantation of a nerve should be performed at a later date. In my experience fine silk has proved to be a satisfactory suture material for repair of nerves. The ends of nerves that cannot be apposed because of loss of substance should be marked with a stainless steel suture to facilitate their localization at a secondary procedure.

Repair of Bone—Fractures should be aligned and fixated with buried Kirschner wires which are later removed. If sufficient bone has been destroyed to prevent apposition of the ends at the initial procedure, the remaining segments of bone may be fixed in their functional position with Kirschner wires, usually placed transversely across the bone and into the adjacent bony structures. An example of this is the through-and-through gunshot wound of the palm of the hand with destruction of the central portion of one or more of the metacarpals. These metacarpal stumps may be fixed by passing Kirschner wires transversely across the hand through the bony stumps and into the intact metacarpals on each side of the fractures. The presence of a fracture does not militate against use of pedicle flaps. I have not observed that fractures fixed by this method are displaced during the period of attachment of the flap. Primary bone grafts are not often used in these injuries but may be successful if the wound is clean and of very short duration.

Tendons—Extensor tendons should be repaired primarily unless the point of repair is in contact with a bony fracture or an open joint. Sutured extensor tendons may be covered with a pedicle flap with the expectation of obtaining a mobile tendon. Flexor tendons in the proximal palm are usually repaired primarily. Those in the distal palm and digits should be repaired as a secondary procedure. Such procedures as tendon transfers and tendon grafts should not be done in the initial repair of this type of injury. However, the future use of tendon grafts or transfers must be considered in the design and application of the pedicle flap.

Secondary Repair

With compound injuries of the hand secondary reconstruction is often required for optimal function. After initial re-

pair a variable period is devoted to regaining mobility with exercise, physical therapy and use of dynamic splints when indicated. It is usually best to delay secondary procedure for six or more months or until full mobility of the hand and maturation of scar tissue have occurred.[3] Earlier operative procedures are indicated for nerve repair and to relieve malposition of the hand or digits.

Secondary nerve repair in this type of injury may require advancement or transplantation to replace a missing segment of nerve. Usually, approximately 4 to 8 cm. of length can be gained at the wrist by transplantation of the ulnar nerve at the elbow and dissection and advancement in the forearm. In such repair of mixed motor and sensory nerves, return of sensation has been good but return of motor function to the intrinsic muscles of the hand has occurred in a minority of cases. If the missing segments of nerve cannot be replaced by advancement and transplantation, a nerve graft may be used. Return of sensory and motor function has occurred in only a minority of these cases. Repair of the pure sensory nerves of the hand is, of course, attended with a high incidence of success.

Tendon transplantation is often necessary to compensate for loss of motor function in these nerve injuries. If, by virtue of the type of injury, the prospects of return of motor function are poor, tendon transfer may be combined with secondary nerve repair, usually eight to twelve weeks after resurfacing is completed. In general, I have used multiple sublimis transfers for median and ulnar nerve palsies and transfer of the wrist flexors for radial palsy. If intrinsic motor function does eventually recur, these tendon transfers are not a detriment to the hand. Indeed, they serve well as a built-in dynamic splint during the period of neural regeneration. Even with the eventual return of intrinsic motor function, we have found that these tendon transfers shorten the period of disability for the patients and return them to a gainful occupation at an earlier date.

Replacement of destroyed tendons is more difficult than in the hand that has not suffered extensive loss of skin. Tendon repair, transfer, or graft must be beneath a vascular surface tissue and, consequently, free skin grafts in these areas must be replaced with pedicle flap tissue for tendon reconstruction. Even a pedicle flap surface creates difficulties in regaining mobility of repaired tendons. The tendon repair, transfer, or graft is placed through the fatty layer of the flap, if possible, but the problem of scar fixation of the tendon, particularly at the borders of the flap, is still present.

Apposition of tendon ends is preferable to substitution, and tendon transfer, if practical, is preferable to use of a tendon graft. In general, the minimal number of sutured tendons, transfers or tendon grafts is desirable. Tendons that serve a common or similar function may be grouped together and repaired with a single transfer or graft; e.g., repair in the proximal hand of the extensor tendons of the four fingers by a single graft or transfer.

My experience with use of free tendon grafts has apparently been comparable with that of others. Such grafts, if placed through soft vascular tissue, often gain useful mobility. When in contact with dense scar tissue, bare bone or other unyielding tissue, these grafts rarely develop an optimal range of motion.

Bony continuity is restored with bone grafts usually from the iliac crest. Grafts from this area are easily removed and afford a good source of cancellous bone. The graft is shaped to the desired contour and consists largely of cancellous bone with only enough cortical bone to give adequate strength. Fixation is with Kirschner wires. Again, a vascular surface tissue is essential for survival of the graft, and free skin grafts and scar tissue must be replaced with a vascular pedicle flap. Repair of the metacarpals and phalanges by bone graft is usually attended by good function.

During procedures for repair of the deep structures revision of surface tissues may be accomplished. Defatting of flaps and revision of scars often require multiple procedures, and time may be conserved by combining this with repair of other structures.

Summary

A plan of reconstruction must be formulated before initial treatment of compound injuries of the hand. Early or immediate resurfacing is the *sine qua non* of successful reconstruction of these injuries. Initial resurfacing with pedicle flaps is indicated by exposure of tendons, joint, bone and on occasion, nerves, and if future reconstruction is contemplated. Treatment should be initiated only after careful evaluation of the extent of the injury.

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Historical Notes

Do not the same general laws which govern the rest of the animal kingdom apply with equal force to Man? Has not the Almighty placed his stamp, intellectual and physical, upon the races of men as strongly as he has upon the species or varieties of other genera? We have already stated what the works of Champollion, Rosellini, Lepsius, and other hieroglyphic scholars so fully prove, that the same races of men have been living around the Mediterranean for 3500 years. Since the literature of China and India have been laid open to us, we have the evidence that Mongol, Malay and Hindoo types are quite as old. * * * The permanence of these human types, I repeat, is no longer a point of dispute; so long as the physical causes which have for ages been acting on them remain unchanged, they remain indellible.

J. C. Nott: Instincts of Races, New Orleans M. & S. J. 19:5 (July) 1866.

Medicine and Marketing*

• A timely and interesting discussion on a subject that has received much unfavorable publicity.

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New York, N. Y.

I WOULD like to examine, with you, the relationship between good pharmaceutical practice and good business practice—between medicine and marketing.

Why, you may ask, is there any problem in defining the area in which the pharmaceutical manufacturer operates. What are the peculiarities which distinguish this business from any other? There seem to be two widely held views on this subject. On the one hand, we are looked upon by many observers as simply another manufacturing industry, probably not too different in basic structure from, say, the nuts-and-bolts business. Others, however, seem to feel that we should be devoted, dedicated scientists whose sole concern is the battle against the age-old enemy—disease. These are, admittedly, two extreme views, but they serve to illustrate the peculiar problem which we face in conducting our business.

I'm sure that if I were to ask this audience the meaning of the initials AMA, your reply would correctly identify the American Medical Association. However, the same question asked of a group of my business associates would draw an equal number of mentions of the American Marketing Association and the American Management Association.

An advertising agency in New York has a slogan which they identify by the initials USP. No, they do not refer to the United States Pharmacopeia. Their initials stand for *U*nique *S*elling *P*roposition, an attribute which they claim to build into every advertising campaign they prepare for their clients.

How, then, do we equate these two apparently divergent views? In the words of the Old Gold ads, are we tobacco men or medicine men? Or, as Time magazine put it in a cover story on the late George Merck, is medicine for people or for profits?

I am not here as an apologist for the pharmaceutical industry, nor do I intend to point piously to the discovery of so-called "miracle drugs" in justification of practices for which we have been criticized. I would simply like to present some of the facts of life about our business in the hope that it will give you a better understanding of us. It is important to us that you know these things because you, through your publications and your daily contacts in the medical profession and with the public, are in a position to educate and influence many others who may have erroneous ideas about us.

It is easy to understand why there should be misconceptions about us. We had our roots in the alchemy of antiquity and, until recently, an air of romance and magic has surrounded the practice of pharmacy. Just a few years ago the prescription was written by the doctor in a mysterious ancient language. It was compounded by the pharmacist in a remote, private part of his establishment in an atmosphere suggestive of witchcraft and sorcery. More often than most of us are willing to admit, all this hocus-pocus accomplished was the successful concealment from the patient of the dubious therapeutic properties of his medication.

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† Vice President of Thos. Leeming & Co., Inc., and President-Elect of the Pharmaceutical Advertising Club, Inc.

Today, just a few years later, the veil of mystery has been lifted. Drugs have been developed with known, specific pharmacologic properties and are usually prescribed by brand name. The pharmacist, no longer required to compound mysterious potions, is assuming a new role as therapeutic consultant to the physician; as the man to whom the physician turns for information about the latest drugs, their actions and side reactions, their indications and dosage. The public, which is, after all, the greatest beneficiary of these advances, is living longer and is apparently spending this extra time devouring newspaper and magazine articles on health subjects or debating the relative merits of the newer corticosteroids.

The government, too, is finding it interesting and, perhaps, politically expedient to take a searching look at us. Few people realize that we are already one of the most strictly regulated industries in America. We must comply not only with the requirements of federal drug legislation and rulings, but every state and many municipalities have their own drug laws. I mentioned earlier that we differed markedly from the nuts-and-bolts business, and government regulation is certainly an important area of difference. Some months ago I showed one of our clinical investigators in private practice a New Drug Application for a drug which he had been testing. He was amazed at the qualitative and quantitative information which we must supply to the Food and Drug Administration on chemistry, pharmacology, safety, efficacy, manufacturing methods, assay methods, and control procedures before we may market a new drug. Today, government interest in drugs is at a new high. Here are the subjects covered by only a few of the bills directly affecting us which were before the Congress at its adjournment on September 14th: amphetamine and barbiturate regulation; a change in the narcotics control law; color additive control; study of drug prices; the labelling of hazardous substances.

Believe me, the age of mystery in our business is over. Don't misunderstand me; we have no objections to being called to account for our stewardship. After all, our business is directly concerned with the public health and we succeed in our endeavors only insofar as we discharge our obligations in a mature and responsible way. However, we deplore the reckless, irresponsible, and unfounded attacks that have been made against us, purportedly in the public interest, but actually stemming from a desire to build circulation and readership or to make political hay. Such recent headlines as "drug profits excessive," "shotgun dosing common" or "little profit for drug companies in cancer research" contribute nothing to any constructive cause. They do, on the other hand, provide powerful ammunition for those who would have all medical care placed under a socialized system.

We welcome intelligent interest in our activities, but the interrogations, investigations and indictments levelled at us today make us feel that there has been something immoral in our having helped the medical profession to bring about a 63 per cent decline in deaths from syphilis, 77 per cent in maternal deaths, and 91 per cent decline in influenza deaths which occurred in the short space of ten years from 1944 to 1954.

Now that the curtain has been lifted, what are people saying about us? During Mr. Khrushchev's recent visit it was suggested that a Truth Squad follow him in his travels and rebut some of his more glaring inaccuracies with factual data. Perhaps today I can perform somewhat the same function for the pharmaceutical industry.

One of the most common criticisms we hear, and I'm sure you have also heard it, is that drug prices are too high. I'm not at all sure I know what "too high" really means because I have the same problem we all share in trying to assess the value of a dollar in terms of current price levels. But let's at least attempt to put the subject of drug prices

into some perspective by examining the relevant facts.

This subject would be far easier to deal with if we were discussing automobiles. A $4,000 price tag on a new car would be explained by the manufacturer on the basis of the relationship between the length, weight, horsepower and appointments of his car in comparison to his competitors. No such easy answer is available to us, because our prices bear no relationship to the size of the capsule or the flavor of the elixir. Neither do we price our drugs on the basis of the urgency of the need for their use. A drug which saves lives may, and frequently does, cost the same as another drug which may be used only for symptomatic relief. Consider, for example, the cost of penicillin which dropped so precipitously as usage increased and manufacturing methods were improved.

Since we can't discuss our prices from the standpoint of product features, what else can we use as a yardstick? Let's look first at the absolute figure, the dollar cost of a prescription. In 1929, the surveys tell us, the average cost of a prescription was 85¢. By the post-war year of 1946, this had risen to about $1.50 and, in 1958, the average prescription price was almost exactly $3. You may feel that $3 is a high figure or a low figure, but almost certainly you will want to know what happened to all the prescriptions costing $10 or more that you have personally paid for. According to a national survey conducted in April of 1958, exactly 1.5 per cent of all prescriptions were priced at $10 or more. Let's not forget that, although numerically infinitesimal, these are the prescriptions which are magnified far out of proportion to their importance in the over-all picture.

These absolute prices do not really tell us very much without some frame of reference. I have said that the 1929 prescription cost 85¢. In terms of real income, it "cost" one hour and thirty-one minutes of work at prevailing wages. The 1958 prescription, in the same terms, "cost" one hour and twenty-six minutes of working time, actually less than in 1929.

Another way of looking at over-all drug costs is in terms of what consumers spend for other goods and services. I could preach a sermon on the relationship between the $18.74 per capita drug and pharmaceutical cost in 1958 and the $36.64 spent for tobacco products and $52.93 for alcoholic beverages, but this would add little to the logic of our discussion. Perhaps it would be more meaningful to compare drug costs with the cost of the other elements of medical care. For example, since 1939 hospital rates have risen 310 per cent; dentists' fees 90 per cent; physicians' fees 88 per cent; yet the cost of all prescriptions and drugs went up 46 per cent. If drug prices had risen as much as all other prices since 1939, it would cost the consumer at lease an additional billion dollars to buy the drug preparations now consumed. Surely these data are not even remotely suggestive of excessive drug prices, and they do not even take into account the tremendous increase in the effectiveness of the drugs dispensed today.

I don't know of any motivational research studies on the subject, but it seems to me that most patient complaints about prescription prices must arise from the relatively few $10 or $12 prescriptions. The physician can be extremely helpful here in giving a word of explanation to the patient when he orders these expensive drugs. Too, even when the prescription is not in the $10 range, we must realize that it is a purchase more or less forced on the patient by circumstances of illness beyond his control and, like a parking fine, it is a natural source of complaint.

If prescription prices are not too high, how do we account for what are frequently termed our "fabulous profits?" Here, again, I think a few facts are in order. Last year our industry averaged about 13 per cent of sales in net profit after taxes, a figure entirely comparable to other large dynamic manufacturing

operations. For example, U. S. Steel made 11 per cent net profit on its 1958 sales, and just recently I have seen Gillettes' and Eastman Kodak's interim 1959 reports showing a 14 per cent on sales. It seems to me that a great many people not well versed in financial matters confuse rapid growth with excessive profit. We have seen a tremendous expansion in our business in recent years as new, more effective drugs have been developed and come into widespread use. As sales have increased, our profits have increased and our stocks have risen in value. The company with annual sales of 10 million dollars ten years ago may be doing 100 million today. Its profits will have grown tenfold, its stock will have risen accordingly and probably have been split a few times and, without doubt, it will have been accused of profiteering by the misinformed who confuse growth with profit.

I happen to believe in our system of free competitive enterprise, and I think it is healthy, not immoral, for any legitimate business to make a profit. In the pharmaceutical industry, I do not feel it would be stretching a point to say that future progress in drug therapy depends upon making profits. We spend almost $200 million dollars a year in an intensely competitive research effort, a vast program which would have to be curtailed or abandoned if we were not financially able to continue and expand it.

Let's examine another major area in which our industry is different from most others. As you know, we are sometimes referred to as the "ethical" drug business, a term which is frequently misunderstood as implying that some other segments of the industry are unethical, possibly immoral, and probably due for a Federal Trade Commission investigation. It is an unusual term, unique to our business, and I daresay that few of you have heard of an ethical plumbing business or an ethical tobacco manufacturer. The term is widely misinterpreted as applying to prescription legend drugs when, in actuality, it merely refers to our practice of restricting the advertising of our products to the medical profession.

Here, again, is an area in which we have been criticized. Time does not permit me to go into a detailed analysis of each phase of our promotional activities, or to counter with the facts each complaint that has been voiced. In general, it may be said that our critics have accused us of going overboard in lavish promotion and have concluded that, in some way, this has been responsible for the so-called "too high" drug prices I mentioned a few minutes ago.

Strictly from the standpoint of dollars and cents, an editorial in the Journal of the American Medical Association a few years ago pointed out that if all advertising of a popular broad spectrum antibiotic had been cancelled, the price to the consumer could have been lowered from 50 cents per capsule to 48 cents, hardly a major saving if the value of our promotion to the physician as a form of postgraduate medical education is given proper consideration. The pace of therapeutic progress today is too rapid for the physician to render the best possible medical service to his patient without keeping up with current drug developments.

I said at the outset that I would not be a pious defender of our practices and I do not mean to imply that the material we prepare for physicians is an altruistic service. Ours is a highly competitive business and we do our best, within the limits of scientific accuracy and good taste, to promote our products in such a way as to win the physicians' acceptance. But, just as our operating at a profit insures the continuing availability of funds for research, so the promotion of our products provides the medical profession with an invaluable source of up-to-date therapeutic knowledge.

I have said that ours is an intensely competitive industry, and I would like to point out that competition exerts a most restrictive influence on our activities. Although it may sometimes seem to the physician that every drug company markets a tranquilizer, and that

the number of antihistaminic agents exceeds the U. S. population, the fact is that the product which performs clinically is prescribed and the product which does not live up to its promise is discarded. This is an inexorable law which, in the long run, means that a manufacturer will go into bankruptcy if he habitually introduces new products which do not stand the test of successful clinical usage. We do not, of course, always guess correctly but, believe me, we think long and hard about the advantages of our new product over existing therapy before we make the decision to spend large sums of money on its introduction. We examine our pharmacological and clinical data searchingly. We hope trustingly that our competitors have not beaten us to the gun. And we look apprehensively at a recent report entitled "More Drugs Die Younger as More People Live Longer" which tells us that the rate of obsolescence of prescription products in 1958 was the highest in the ten years during which this grim aspect of pharmaceutical marketing has been measured.

Here, again, the pharmaceutical manufacturer plays a dual role. To the extent that his new product makes a distinct contribution to therapy, its sales success is assured. If his product does not perform, he loses money. Put another way, his own self-interest is best served by the introduction of products which best serve the health needs of the nation.

I raised the question earlier of whether medicine is for people or for profits. There is no doubt in my mind nor, I hope, in yours that the greatest therapeutic advances of the past, and the greatest hope for the future, lies in a pharmaceutical industry dedicated to the proposition that medicine is for both people *and* profits.

Historical Notes

Self-love and self preservation are the ruling instincts of every animal and drive even the most untutored races to desire immortality; and, with the hope of attaining it, they seek to propitiate good spirits and evil spirits. It is not the love of the Lord, nor of virtue, that keeps most men in the "narrow path" but the fear of the devil and annihilation. If a little brimstone were not burnt under people's noses once a week at least, the devil would be most likely to drag the mass into the "broad road that leadeth to destruction."

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Editorial

Drugs, Doctors, and Politicians

"Economics is a dismal science." This, in effect, was said by Carlyle over a century ago, and it is even more true now. We see before us the spectacle of politicians advocating free hospitalization for retired Social Security beneficiaries at the taxpayers' expense, criticism of the rising cost of medical care, for which these same politicians are in part responsible, and complaints against the costs of drugs, which are the most effective in all medical history.

The public interest in the price of drugs has recently been attracted by the sensational charges before the Senate Subcommittee on Anti-Trust and Monopoly. There it was stated that the profits were excessive and prices were completely out of line on certain items that various pharmaceutical houses produced. The executives of some of the major pharmaceutical houses were subjected to a sort of inquisition as to why the prices were what they are and what salaries were made by these leaders of one of the world's most important industries.

The manner of presentation, the superficiality of the charges, and sequence in timing in relation to the agitation for the Forand Bill, and the fact that it is an election year, all suggest that there is a plan behind the whole picture. The idea might be to present a tax supported plan as a campaign issue and transfer the battle against State Medicine in Congress to the area of partisan politics.

Since the charges of excessive cost of drugs have been made, it behooves us as physicians to interpret the economics of this situation to our patients and to the public. Inflation is responsible for about 20 per cent of the increase in the cost of drugs, while all items of consumer spending averaged together have increased 23 per cent since 1947. Although drugs have become more expensive in some instances, the need for drugs has been slightly reduced. In other words, each dose accomplishes more. In the distribution of the medical care dollar, medicines and appliances took 25 cents in 1949, and only 26 cents in 1958. The increase in cost has not been a source of profit to the local druggist. Authoritative investigations

have shown that after taxes and all other overhead expenses, the net profit out of every dollar the drugstore receives for prescription medication is less than 3 cents.

In the Congressional investigation referred to above, the major accusations were against the large pharmaceutical houses. Various charges were made that the big houses sold to the government cheaper than to the druggist; that the drug cost less in foreign countries than it might cost here; that one firm made a profit of 7,079 per cent on a new drug combination; that the promotion, sales, and distribution costs were too high and, in substance, that the pharmaceuticals were for profits and not for patients.

In order to answer these several types of criticisms, a general statement of the position of the pharmaceutical industry would be helpful. Elsewhere in this issue is a general review by a prominent worker in that industry.

Next, it must be stated that in order for medicine to have drugs with which to work, manufacturers have to conduct their affairs in such a way as to be able to stay in business. This means they must show a profit, and in order to show that profit they must have conducted research in order to find drugs which may be helpful. Having done so, they must go through an involved procedure of proving, testing, and sales promotion before distribution to the patient can provide any benefit to him. Involved in this process are two enterprises, both expensive and necessary.

One is research to discover and prove the value of a drug and the other is the presentation of the drug to the physician in order that the public may eventually benefit from it. The physician must learn of the drugs through the medical communications of the pharmaceutical industry before he can direct them to the patient. The facts about the drug are promoted through trade advertisements, but principally, by personal presentation. Approximately 90 per cent of the one million six hundred thousand prescriptions which are filled each day could not have been prescribed ten years ago, because they did not exist. Therefore, what the physician knows of 90 per cent of drugs in current use must have been learned in the last ten years in such ways as the industry made available to him.

Competitive conditions in the industry have stimulated the various houses to their utmost in research and production of remedies. A certain phase of medical research has shifted from the medical schools to the pharmaceutical industry. The industry allocated one hundred and ninety million dollars to research in the current year. The result of these expensive researches is by no means predictable. It is expected that a large part of the expenditures in any field will be unproductive. The net result, however, is that we have the most effective drugs and are advancing at the most rapid rate of any time in history.

Answering the contention that the public has had to pay too much for what it has received, many facts are to be considered. One of the first of these is when and in what guise outside of socialism is the federal government to undertake to say what the profit from an enterprise should be. Again, dividends per share in the largest pharmaceutical companies vary from 0.5 per cent to 2.7. An inquiry to seven of the most important houses brought out the fact that they were allotting from 1.3 to 15.7 million dollars per year for research, and this represented from 50 to 300 per cent of the annual dividend of the respective companies. The average for the pharmaceutical industry as a whole, was about 13 per cent net profit after taxes. This compares favorably with the general average of stable national American corporations, which runs from about 11 to 16 per cent.

These figures prove that the prices of drugs are not out of line. The critics fail to take into consideration that the cost of the drug must include: research, fail-

ure, production, promotion, and distribution. Interference with the conditions under which the pharmaceutical industry works may stifle initiative and retard progress. To borrow from another editor, let it not be said that American profits are not without honor save in their own country.

ORGANIZATION SECTION

The Executive Committee dedicates this section to the members of the Louisiana State Medical Society, feeling that a proper discussion of salient issues will contribute to the understanding and fortification of our Society.

An informed profession should be a wise one.

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REGIONAL CONFERENCE A SUCCESS

The Regional Conference on Aging recently held in New Orleans on February 17-18 under the direction of the American Medical Association's Council on Medical Services in cooperation with the State Medical Societies of Arkansas, Mississippi, Texas and Louisiana, was, in our opinion, most successful. The attendance was exceptionally good. More than 500 registered for the meeting. The meeting was held at the Roosevelt Hotel and many outstanding people from all walks of life were in attendance from the sponsoring states.

An excellent program was offered with outstanding and widely known speakers of prominence in their respective fields participating in the Conference.

We had a receptive and attentive audience vitally interested in the health and care of our older citizens.

The following subjects of interest were on the program and treated by most able and well chosen experts in their respective fields of endeavor:

Medicine's Blueprint for the New Era of Aging

Status of the Senior: The Pattern Today

Capabilities of Seniors: An Untapped Resource

Achieving the Promise: Areas for Group Action

Prevention's Role in Successful Aging

Preparation for Living

Positive Health: Today's Objective

Successful Retirement: A Formula for Fulfillment

An Informed Public: A Leadership Obligation

The Basic Challenge Today: A New Attitude Toward Aging

A Look Ahead in Health Care, A Symposium

A Rural Home Care Program

Rehabilitation in Nursing Homes

Progressive Patient Care

Financing Health Services, A Symposium

The Community's Responsibility

The Medical Profession's Role

The Future of Prepayment Plans for Seniors.

The meeting was closed with a Buzz Session with audience participation.

These subjects were treated by essayists well informed and specifically selected for the respective subjects assigned, and they performed in a manner to the credit of their specialties and themselves.

At the luncheon meeting, we were treated to a masterful address by Dr. Milford O. Rouse, Vice-speaker, House of Delegates, American Medical Association, and Dr. Blasingame, Executive Vice-President, American Medical Association spoke Thursday afternoon on "The Future of Prepayment Plans for Seniors".

Space does not permit us to mention all the prominent speakers.

However, we would like to give you the following names of our local doctors who participated rather conspicuously in the program; Dr. W. Robyn Hardy, our President; Dr. O. B. Owens, our President-elect; Dr. Philip H. Jones, one of our delegates to the AMA; and Dr. Robert E. Gillaspie, Chairman, Louisiana State Medical Society Committee on Aging. We were also most ably represented by two of our lay citizens, Mr. Carl Corbin, Editor, New Orleans States-Item and Miss Margaret Moore, Consultant on Nutrition, Louisiana State Board of Health. We are also very appreciative of services of Rev. John F. Keller, Rev. Nat H. Melbert and Rabbi Mendell Silber who gave the invocations.

In closing, we want to congratulate Mr. George W. Cooley, Secretary and Mrs. McConnell, assistant Secretary, AMA Council on Medical Service, and Mr. Roy Miller for their untiring efforts in preparing this program, and for the splendid manner in which the meeting was conducted.

Those of you who missed this meeting lost a golden opportunity to attend a most interesting and instructive program.

A COMPLACENT ATTITUDE WILL NOT WIN

Don't let your drive to defeat the Forand Legislation lapse into complacency. A strong appeal is being made for all Parish and District Societies to continue a strong campaign in your respective areas against any Forand type legislation. Send resolutions from your Societies, Chambers of Commerce, Civic Clubs and other organizations to our Senators and Congressmen, requesting that they oppose this type of legislation (H. R. 4700). Personal letters from every doctor and from as many of their patients as is possible should also be sent. Send copies of all resolutions and letters to Representative Wilbur D. Mills, Chairman of the Ways and Means Committee.

This is a fight for your survival, so don't let yourself down.

NOMINATIONS FOR PRESS AWARDS

Since this is the last chance to send in your nominations for Press Awards, we would respectfully request that you submit clippings of any outstanding articles, features, editorials or original series of articles on health or medicine published in your home town or weekly newspapers. It is requested that this information be sent to Society headquarters as soon as possible. The winning newspaper will be presented with the award in Baton Rouge at our Annual Meeting.

MEDICAL NEWS SECTION

CALENDAR

PARISH AND DISTRICT MEDICAL SOCIETY MEETINGS

Society	Date	Place
Ascension	Third Tuesday of every month	
Calcasieu	Fourth Tuesday every other month	Lake Charles
East Baton Rouge	Second Tuesday of every month	Baton Rouge
Lafayette	Second Tuesday of every month	Lafayette
Morehouse	Third Tuesday of every month	Bastrop
Natchitoches	Second Tuesday of every month	
Orleans	Second Monday of every month	New Orleans
Ouachita	First Thursday of every month	Monroe
Rapides	First Monday of every month	Alexandria
Sabine	First Wednesday of every month	
Tangipahoa	Second and fourth Thursdays of every month	Independence
Second District	Third Thursday of every month	
Shreveport	First Tuesday of every month	Shreveport
Vernon	First Thursday of every month	

SPRING MEETING SIXTH DISTRICT MEDICAL SOCIETY

The Sixth District Medical Society will hold its Spring meeting on April 2 at 2:30 p. m., Capitol House, Baton Rouge. The program includes:

"Evaluation and Therapy of Bleeding States," by Dr. Charles C. Sprague, New Orleans

"Hypnotherapy, Use and Abuse," by Dr. Russell Monroe, New Orleans

"Rubella in Pregnancy," by Dr. James Atkinson, Baton Rouge

"Clinical Significance of Infections with Acid-Fast Organisms," by Dr. Dwight Danburg, Greenwell Springs

Clinicopathologic Conference—Dr. Bryan Luikart of Baton Rouge, Moderator

In addition, there will be a dinner in the Grand Ball Room, with a reception hour. Guest speaker will be Mr. Edwin Bernard, Executive Vice-President, Edison Electric Company, New York, who will speak on "The Role of the Physician in Preserving Freedom in the U. S. A."

This program is being co-sponsored by the Louisiana Academy of General Practice, and is approved for 3 hours credit, Category 1.

RADIOLOGICAL SOCIETY OF LOUISIANA

The Radiological Society of Louisiana met recently and the following new officers were elected: Meyer D. Teitelbaum, M. D., New Orleans, President; Agrippa G. Robert, M. D., Baton Rouge, Vice-President; and Robyn Hardy, M. D., New Orleans, Secretary-Treasurer.

NEWS RELEASE FROM SOUTHERN MEDICAL ASSOCIATION

The Section of Ophthalmology and Otolaryngology of the Southern Medical Association announces that they are now accepting papers by physicians of either specialty living in the area of the Southern Medical Association for consideration for presentation at the next annual meeting to be held in St. Louis, Missouri from October 31 to November 3, 1960.

The paper or an abstract of the paper may be sent directly to the Secretary, Dr. Albert C. Esposito, Suite 1212, First Huntington National Bank Building, Huntington, West Virginia as soon as possible.

TRUDEAU SCHOOL OF TUBERCULOSIS and OTHER PULMONARY DISEASES

Forty-Fifth Session

1960

The Trudeau School of Tuberculosis and Other Pulmonary Diseases, which will hold its Forty-fifth Session from June 6th to 24th, 1960, continues to provide a unique opportunity for training in the field of chest diseases. This annual postgraduate course, conducted under the auspices of the Trudeau Foundation and supported by the Hyde Foundation, is able to provide outstanding instruction at a minimal tuition of $100.00 for a three weeks session. Attendance at the Trudeau School carries with it some distinction as well as a thorough review for specialization in pulmonary diseases or for work in public health involving tuberculosis.

In addition to the local medical faculty consisting of some forty doctors from Saranac Lake, Ray Brook State Tuberculosis Hospital and Sunmount Veterans Administration Hospital, about thirty of the leading teachers and investigators in the Eastern United States and Canada are brought to Saranac Lake each year to lecture or to conduct seminars in their special fields.

Approximately half of the time is devoted to tuberculosis and the other half is divided between such subjects as silicosis, pulmonary fibrosis, emphysema, fungus infection, sarcoidosis, pneumonias and intrathoracic tumors.

The Trudeau School, in its environment, gives its students a chance to combine a great educational experience with an enjoyable holiday in

the most beautiful part of the Adirondacks, among pleasant companions. The enrollment is necessarily limited and therefore application should be made early. A few scholarships are available for those who qualify.

All inquiries should be addressed to the Secretary, Trudeau School of Tuberculosis and Other Pulmonary Diseases, Box 500, Saranac Lake, N. Y.

WEST VIRGINIA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

The program of the West Virginia Academy of Ophthalmology and Otolaryngology has now been completed for their annual meeting at the Greenbrier Hotel, White Sulphur Springs, West Virginia, April 10-12, 1960.

Among the guest speakers will be:

Dr. Harold G. Scheie, Professor of Ophthalmology, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania. "The Surgical Management of Glaucoma" Part I and Part II

Dr. Charles E. Iliff, Associate Professor of Ophthalmology, John Hopkins University School of Medicine, Baltimore, Maryland. "Adult Ocular Tumors"

Dr. Oscar T. Becker, Clinical Associate Professor of Otolaryngology, University of Illinois School of Medicine, Chicago, Illinois. "Plastic Surgery in Otolaryngology"

Dr. Helen J. Ossofsky, Assistant Professor of Pediatrics, Georgetown University, Washington, D. C. "Pediatric Ocular Tumors"

Dr. John T. Dickinson, Department of Otology, University of Pittsburgh, Pittsburgh, Pennsylvania. "Modern Treatment of Otosclerosis"

There is a non-member registration fee of $10.00 to cover all the social and scientific sessions. For further information contact the secretary, Dr. A. C. Esposito, First Huntington National Bank Building, Huntington, West Virginia.

TULANE LECTURESHIP IN SOCIAL PSYCHIATRY

The second annual lecture in social psychiatry at Tulane University will be delivered by Dr. John Whiting, Director of the Laboratory of Human Development of the Graduate School of Education at Harvard University. The title of the series of two lectures he will give is Social Structure and Child Rearing. The lectureship in social psychiatry is made possible by a grant from the Mona Bronfman Sheckman Foundation of New York City. Lecturers are alternately a psychiatrist and a social scientist. Co-chairmen of the lectureship are Dr. Forrest E. LaViolette, professor and chairman of the department of sociology, and Dr. Harold I. Lief, associate professor of psychiatry. Dr. Whiting's lectures will be held at Tulane University, March 17 and 18, 1960.

SALK VACCINE REACTIONS ARE ONE IN A MILLION

Reported reactions to Salk polio vaccine thus far are so low as to make it unique among immunizing agents, according to Dr. Charles N. Christensen, Indianapolis.

Writing in the Oct 17 Journal of the American Medical Association, Dr. Christensen, medical division of Lilly Research Laboratories, said there have been only 284 reaction complaints in connection with 184,000,000 doses of Eli Lilly and Company manufactured vaccine. Of these, only 146 could be called possibly significant—a complaint rate of 1 per 1,200,000 doses.

One hundred thirty-eight complaints were of burning or stinging pain on injection and were regarded as less significant.

In six instances a clinical picture resembling polio was recorded. Weakness in the extremities not diagnosed as polio was reported three times, according to the article. In two patients it was transient. In the third case, an adult developed weakness in his left leg after a second injection and more severe weakness after a third injection.

Dr. Christensen stated that evaluation of polio possibly caused by the Salk vaccine is difficult, since some of the millions of persons immunized almost certainly were infected at the time of vaccination — or they acquired infection soon after receiving the vaccine.

He concluded, "It seems likely that cases of poliomyelitis which occurred after injections of the vaccine were coincidental to its use."

Nine cases of encephalities were reported. In none of these were laboratory data available to identify the cause of the disease, according to the article.

Allergic reactions also were considered a potential hazard. But in 1954 when 7,507 children were test inoculated, only one instance of hives was encountered.

Penicillin also has been incriminated as a cause of allergic reactions after vaccination. It is impossible to omit antibiotics from the manufacture of Salk vaccine, Dr. Christensen noted, since they are essential to the prevention of bacterial contamination of the tissue culture. He pointed out that the incidence of allergic reactions has been so low, it has become difficult to determine if the vaccine itself was responsible. A very high degree of penicillin sensitivity would have to exist—a sensitivity so high that it is rarely found, he continued.

The one-in-a-million complaint figure is based on all complaints received from physicians, and in many cases the physician indicated he did not believe the reaction was related to the Salk

vaccine. He reported either for information or in the course of an inquiry, according to Dr. Christensen's article.

ARTIFICIAL KIDNEY HAS FEW LIMITATIONS

The artificial kidney can be used to treat just about anyone, whether he is very old, very young, or very ill, the machine's inventor said recently.

Dr. Willem J. Kolff and his associate, Dr. William A. Kelemen, Cleveland Clinic Foundation, said if the machine is skillfully used it carries little danger.

Their statement appears in the Oct. 3 Journal of the American Medical Association.

The artificial kidney consists of a cellophane coil resting in a stainless steel tub containing a special solution. A plastic tube is connected to a leg artery and the blood is forced into one end of the cellophane coil. The blood flows through the coil and back into the body through a tube connected to a vein in the arm.

The machine duplicates the work of the kidneys, removing poisons and chemicals from the blood. It is used in uremia and other conditions in which the kidneys fail to work. It is also used when a person has been poisoned, since it can remove poisonous substances 20 times faster than the kidneys.

All major medical centers have the machines and a trained team of physicians to operate them.

The changes in blood volume produced by the use of the artificial kidneys can cause shock or abnormally rapid blood movement, the doctors said. These have been considered to be especially dangerous for the very young, the very old or the very ill. However, skillful use of the machine can prevent them, the doctors said.

The machine should be used whenever there is the slightest possibility of recovery, they said, adding, "When the recoverability of a patient is questionable, he should be given the benefit of the doubt."

The advantages and almost certainty of clinical improvement whenever uremia or fluid retention play a part in the illness far outweigh the alleged dangers of the machine, they said.

1,100 PERSONS HELP SET ASSOCIATION'S POLICY

The American Medical Association's broad activities for helping to improve the nation's well-being "sprout from a tree measuring a figurative 1,100 people high," according to the association's Oct 10 Journal.

These persons, many of whom serve in week-end and late night sessions, donate as many as 100 hours yearly to the association. None is on the A.M.A. payroll.

"The volunteering M.D.'s (and Ph.D.'s and LL.D.'s and B.A.'s too) range in name from A to Z and come from all 50 states," the Journal article said. - "Their talents enrich 13 A.M.A. councils, more than 100 committees, 20 sections of the Scientific Assembly, 10 specialty journals, and approximately a dozen liaison groups with other organizations."

In addition, there are members of the Board of Trustees and the House of Delegates, the group who makes the final policy decisions for the A.M.A.

NEW CLUE TO CAUSE OF LUPUS ERYTHEMATOSUS FOUND

The outlook for lupus erythematosus, a disease long considered to be very serious and nearly always fatal, is not so bleak after all, two Detroit doctors said recently.

Reporting a study of 100 cases in the Oct. 24 Journal of the American Medical Association, Drs. Clarence E. Rupe and Stewart N. Nickel, Henry Ford Hospital, said the disease is more benign than previously suspected. They also offered a clue to the possible cause of the disease.

Lupus erythematosus, also called LE, was once considered to be only a skin disease, because of its typical butterfly pattern of rash across the bridge of the nose. However, it is a systemic disease, affecting the joints and such organs as the liver and kidneys.

Treatment with artificial hormones, such as those used for arthritis, has a beneficial effect on the disease process by slowing it down and by carrying the patient through crises which once would have been fatal.

The benign course of the disease was illustrated by the fact that only 2 per cent of the total group "proceeded to incapacity," the doctors said. In addition, more than half of the men remained in good health and at full capacity.

Fifty of the patients survived the disease at least 10 years after the onset, and 45 of these are still living. Duration of the disease ranged from 10 months to 36 years.

The clue to a possible cause of the disease lies in the fact that many of the patients had streptococcic infections just prior to the onset of LE. Many had typical "strep throat" infections, while others had other streptococcic infections, such as boils or ear infections. This suggests that hypersensitivity to the streptococcus bacillus may be an important factor in the disease, the doctors said, adding that this association may eventually produce a means of prevention.

BOOK REVIEWS

Emergency War Surgery. NATO Handbook. U. S. Armed Forces issue of Nato Handbook prepared for use by the Medical Services of NATO Nations. Washington, D. C. Government Printing Office. 1958, pp. 411, Price $2.25.

In his foreword to *Emergency War Surgery*, subtitled *NATO Handbook*, Dr. Frank B. Berry, Assistant Secretary of Defense (Health and Medical), explains the origin of this manual. It is the modification, for the use of the U. S. Armed Forces, of the NATO Handbook developed at SHAEF by a committee of three surgical consultants representing the military medical services of France, the United Kingdom and the United States. These consultants were assisted by observers and written recommendations from other NATO nations.

One must applaud the concept of developing a uniform guide to surgical practices for all members of the NATO alliance. This is in line with present-day efforts to strengthen the alliance in all respects; not the least important of these is the efficient accomplishment of humanitarian endeavors. Equally, one must applaud the provision of a single surgical manual for the use of all U. S. Armed Forces, Army, Navy and Air Forces. This is as it should be. There are no fundamental differences in trauma as it occurs in any service, and there should be no fundamental differences in the principles and techniques of its management. This book, as Dr. Berry has well expressed it, is intended "For the attainment of uniform guidance . . . the better to accomplish our joint medical responsibilities."

This small text of only 411 pages, including the 33-page index, is ample testimony to the truism that good things can and do come in small packages, and, it might be added, extremely attractive packages. On first glance, the possibility of covering such a vast subject as emergency war surgery in a single volume, much less so small a volume, in anything but a superficial fashion seems almost preposterous. It is not necessary, however, to read many chapters to realize that this objective has been accomplished. The anonymous authors have managed to include all the basic principles and techniques of this type of surgery and have done it superbly.

The book is beautifully produced and printed, on excellent quality paper. The silver lettering and silver Department of Defense seal on the flexible black leatherette cover make it distinctive. It was sized to fit the hip pocket of the field uniform, and civilian physicians, to whom it is most heartily recommended, should have no difficulty in stowing it away either.

The book is divided into four sections, (1) types of wounds and injuries, (2) the response of the body to wounding, (3) general considerations of wound management, and (4) regional injuries. An introductory chapter deals with general considerations of forward surgery, and there are two appendices. The first is a glossary of drugs with national nomenclatures. The second is a collection of useful tables.

At the end of each chapter is a brief presentation in which the content of the special chapter is related to the management of mass casualties. This is a timely, grimly realistic note, which should impress us once again with the realization of how near such a disaster may be.

One thing that promptly fascinated this reviewer was the span of time and medical knowledge implied in this book. There are, as just noted, sections on the management of casualties in thermonuclear war, and there is a chapter on radiation injuries, with which, as yet, we have had mercifully little experience. But there is also a chapter on cold injury, which plagued the soldiers of Alexander of Macedon, which accounted for some of Napoleon's worst defeats, and which was still a major problem in World War II and the Korean War. The discussion of air evacuation strikes another very modern note. No doubt, as time passes, this method will be used more and more. Helicopters proved most useful in Korea and Lebanon. But air evacuation is not the universal answer, and a thoughtful reading of the discussion of the indications and contraindications for its use is recommended to those who believe that it is.

A number of sections and chapters deserve special comment:

1. The introductory chapter on administrative considerations sets forth the first thing which a newly inducted medical officer must learn. There is a logistic problem in the care of every battle casualty, and without due regard for it, he cannot provide the best medical care for his patients, no matter what his surgical talents may be.

2. The chapter on missile wounds makes very clear another fact which the newly inducted medical officer must be made to realize before he begins to handle combat casualties. This is that the damage caused by a missile extends far beyond its evident track. Until the military surgeon grasps that fact, debridement, which is the basis of all war surgery, will be incomplete, and infection, hemorrhage, and death may be the consequences.

3. The chapter on shock is admirable. Here, in 15 pages, there are presented the pathogenesis of the condition; the physiologic disturbances which it produces—or which produce it; the patterns which it may assume and which are set forth in an excellent table (p. 100); the principles of resuscitation; the selection of replacement fluids; and the precise amounts of these fluids to be employed in special circumstances.

4. In the same section of the book, on the response of the body to injury, is an equally admirable discussion of the renal factor in trauma and the puzzling, highly fatal condition known as lower nephron nephrosis. Like shock, this is a difficult subject to present clearly, but it is well presented from every standpoint. Like shock, it also illustrates one of the desirable features of the book, that all material on the same subject is discussed under a single heading, with cross references taking care of other areas in which the subject appears.

5. The chapter on infection is crammed with valuable information and with sound advice on prevention and management, including the rational use of antibiotics. The discussion of gas gangrene deserves particular mention. Surgeons of this generation see practically nothing of it in training or practice and they may fail to realize what a terrifying possibility it is in every combat wound which is not properly managed.

6. The whole section on general considerations of wound management deserves careful study. It begins with the sorting (triage) of casualties, on the performance of which a man's life may be saved or lost. It goes on to anesthesia and then to special categories of wounds (soft tissue, vascular, bone and joint, peripheral nerve, and amputation). It may seem odd for a medical officer who served through the North African and Italian campaigns to say, but it is true, that this is the only really adequate description of the principles and details of debridement which he has ever seen.

7. It was a wise plan to have a special section on regional injuries. The chapters on the chest and abdomen are detailed and thorough. A word should also be said about the excellence of the chapters on craniocerebral and spinal cord injuries, which the inexperienced ambulance interne is particularly likely to mishandle.

This book covers the important principles and techniques which a military surgeon needs to know. It also emphasizes what he needs to know to keep out of trouble. It is especially timely for the present generation of surgeons trained in modern hospitals, who have every bit of needed equipment on hand and trained personnel always at their elbows. When they encounter the casualties of future wars, they will have to shift their mental gears and make haste quickly to make do with what—if anything—is at hand, to improvise what is lacking, and to manage with the help—if any—which is available.

If principles set forth in this book are clearly understood and are correctly applied under field conditions, from the battlefield back through the evacuation hospital, lives and limbs will be saved. It is unfortunate that a book of this kind, logically organized, emphasizing principles yet describing details, free from ambiguities, and reading smoothly and interestingly, was not available when the United States entered World War II. It might have saved the months which elapsed before concepts were clarified and principles and practices standardized.

This is a book which every medical student should own; the schools which are requiring its purchase have taken the proper action. Every interne and every resident should have his own copy. There should be copies in every hospital accident room. Physicians in general practice and practitioners of surgery and the surgical specialties will find it useful for quick reference, for a summarization of modern principles and techniques; it is as up-to date as a current medical journal.

A special word of approval should go to the index, which is clear and complete. The table of contents is unusually detailed, but the book would have lost a large part of its usefulness without a detailed index.

Indeed, almost the only omission which comes to this reviewer's mind is the lack of a bibliography, which is understandable in view of the purposes of the manual. The comment is added, however, because one of the side-effects of this book is the stimulus which it provides to additional reading on the various subjects covered, particularly physiopathologic subjects. This reviewer, familiar with many of the comprehensive modern texts and finding many of them frankly hard reading, has been stimulated to return to them now that he has read the concise, clear, interesting summaries in this small book.

The authors and editors of *Emergency War Surgery* deserve the thanks not only of the medical officers of the three branches of the Armed Services but also of the whole medical profession. The Government Printer also deserves gratitude; at $2.25, this is indeed one of the best bargains of the year.

H. Reichard Kahle, M. D.

Medical Department, United States Army, Surgery in World War II. Neurosurgery, Volume I: Prepared and published under the direction of Major General S. B. Hays, The Surgeon General United States Army; Editor in Chief, Colonel John Boyd Coates, Jr., MC; Editors for Neurosurgery, R. Glen Spurling, M. D., and Barnes Woodhall, M. D.: Associate Editor, Elizabeth M. McFetridge, M.A. Washington, D.C., Office of The Surgeon General, Department of the Army, 1958. 466 pages; illustrated. Washington, D. C., Government Printing Office. Price $5.00.

This book, the first of two volumes dealing with neurosurgery in World War II, is a comprehensive account of the administrative background of this specialty and of the problems of head injuries sustained in combat and their man-

agement. The second neurosurgical volume, now in press, will cover injuries of the spinal cord and of the peripheral nerves.

Any physician who has served in the Armed Forces will understand why 86 of the 399 text pages of this volume are devoted to administrative considerations: No matter what he believed when he entered the service, he promptly learned that the most efficient application of his professional skill was impossible without a background of sound logistics.

One of the editors of the neurosurgical series, Dr. (then Major, later Colonel) R. Glen Spurling, set up the first such service in the Army at Walter Reed General Hospital in May 1942. As this volume makes clear, there was no specialty of neurosurgery in the U. S. Army when this country entered World War II. In fact, neurosurgery had only recently become a sharply defined surgical specialty; the American Board of Neurological Surgery had begun to function only a few months before Pearl Harbor.

Of the many important administrative accomplishments during the war, two are of special significance. The first was the establishment of specialized neurosurgical centers, 19 in the United States, 12 in the European Theater of Operations, and one in the Mediterranean Theater. Without such a concentration of casualties, neurosurgeons, and neurosurgical equipment, it would have been impossible, professionally or numerically, to provide for these casualties the superb care which they received. They constituted about 10 per cent of all battle casualties, and numerically they were next in order to orthopedic casualties.

The second highly significant administrative achievement was the rapid training in neurosurgical principles and techniques of some 125 young, well trained general surgeons. After their training these medical officers worked under the supervision of the very limited number of experienced neurosurgeons in the Army, and, later, many of them held positions of independent responsibility. To them is due a major part of the credit for the superb care which neurosurgical casualties received. In the opinion of many observers, the demonstration of the feasibility and value of this mode of specialty training (it was also employed in other specialties) was one of the outstanding medical accomplishments of the war.

The results of peripheral nerve injuries in World War I had not been good, and the results of spinal injuries were dismal. Under the guidance of the late Harvey Cushing, however, the mortality of head injuries had been enormously reduced before the end of the war, and the management of these injuries in World War II was built on the firm foundation which he laid in the First World War. In the Second World War, sound resuscitative practices, including the liberal use of whole blood, adequate debridement, and, when necessary, bold re-debridement, probably accounted, even more than penicillin, for the greatly lowered mortality in these injuries. Infection was never the problem which it had been in World War I.

New techniques were also introduced, including reconstructive surgery with tantalum plates—now generally replaced by acrylin plates—and operations for the management of such complications as brain abscess and fungus cerebri.

The very complete table of contents shows that there is no conceivable phase of head injuries and their complications which is not dealt with comprehensively and conclusively in this volume. The story of the management of these injuries begins on the battlefield and is carried through their sequelae, including skull defects, speech defects, and post-traumatic epilepsy. The final chapter, a study of the endeavor—the unsuccessful endeavor—to identify inherently lethal head injuries is not the least interesting in the book. The implication of the failure of the endeavor was one of the chief reasons for the brilliant results which neurosurgeons achieved in World War II: It was their reluctance to admit that any wound was inherently lethal. The remarkable case history which ends this chapter is fascinating proof of the unconquerable spirit of both the neurosurgeons and the casualties for whom they cared.

The neurosurgical editors explain in their preface that the material for both neurosurgical volumes was prepared immediately after the war ended but was not published then because of a fundamental disagreement between themselves and the administrative personnel in the Historical Division of the Surgeon General's Office. The editors considered the clinical story of neurosurgery true history, as indeed it is; the administrative personnel did not. The material therefore languished in the Historical Division from 1947 until 1956, when, under new and more understanding policies, it was revived and re-written. It is unfortunate that both volumes were not ready for use in the Korean War. Nonetheless, the knowledge and experience gained in World War II were available and were put to full use. The neurosurgeons who worked in Korea therefore achieved an even lower mortality for head injuries than the low mortality which had been achieved in World War II. Neurosurgical personnel were still in short supply, but the front line was fairly static, helicopter evacuation was efficient, and the casualty who was alive when he reached a MASH installation in Korea had an excellent chance for survival.

The reader is impressed, as soon as he handles this book, with the excellence of the production, including the quality of the paper, the typography, and the fine reproduction of the well selected diagrams and illustrations. The editors, Dr. R.

Glen Spurling and Dr. Barnes Woodhall, chose the authors of the various chapters as admirably as they outlined the subject matter. The book is blessedly free from the documentation and footnotes which are distracting features of so many government publications. The documentation is not missed: The editors and authors serve as their own documentation, for they write with the authority of those who were there and who helped to create the data which they have recorded.

One of the virtues of the book is a very complete index. Sample testings fail to show anything omitted from it.

This reviewer was deeply impressed by the time and effort which must have gone into this volume from the moment it was conceived. It is complete in all respects, and the writing, which is clear, lucid, and interesting, is obviously the product of long and hard work. Such results do not just happen.

The time and effort were well spent. Anyone who is concerned with head injuries will find the reading of this book a rewarding experience. The book is a history of neurosurgery in World War II, but it is also an encyclopedia of the surgical management of head injuries. It deals with combat-incurred head injuries, it is true, but the principles set forth, as well as many of the techniques, can be readily and profitably applied to the management of the head injuries that, unfortunately, are making up an increasingly large part of civilian practice in this age of increasing mechanization.

Everyone connected with the preparation and publication of this volume is to be congratulated upon what has been achieved in it.

RAEBURN C. LLEWELLYN, M. D.

Atrial Arrhythmias, Digitalis and Potassium, Lown, B., and Levine, H. D., New York, N. Y., Landsberger Medical Books, Inc., 1958, Pp 222. Price $6.90.

Drs. Lown and Levine gather in this volume a summary of their own work and the pertinent literature concerning an arrhythmia associated with digitalis intoxication: paroxysmal auricular tachycardia with incomplete atrioventricular block. They particularly examine the role of a deficiency of body potassium in sensitizing the myocardium to digitalis and thus also of the combined effect of potassium deficiency and digitalis in producing P. A. T. with block. Careful attention is given to the differential diagnosis of paroxysmal auricular tachycardia with block and the atrial rhythms (tachycardia and flutter) with which it is frequently confused. Particular emphasis is placed upon the underlying clinical state (sometimes the administration of digitalis in large amount and sometimes in lesser amount in the face of electrolyte disturbances—especially those with obvious potassium loss) and upon the peculiar variability of atrial rate in the toxic rhythm as compared with the others.

The authors are properly cautious in their construction of the hypothesis as to the mechanism of this arrhythmia but offer sufficient clinical observations as to its diagnosis and treatment to make the text recommended reading for physicians who administer digitalis or who treat disturbances of cardiac mechanism or electrolyte balance.

L. G. HORAN, M. D.

Vertigo and Dizziness; by Bernard J. Alpers, New York, N. Y., Grune & Stratton, 1958, pp. 120. Price $5.00.

This monograph is written by a neurologist on a subject of special interest to otolaryngologists and internists as well as neurologists. Although the text is but 99 pages in length, it is surprisingly thorough and very understandable.

A brief review of the anatomy and physiology of the vestibular system is included along with a clear explanation of mechanisms involved in the production of vertigo. Finally, a thorough analysis of symptoms and signs, causes, diagnosis and therapy of the varied causes of vertigo are discussed.

L. J. RUTLEDGE, M. D.

Regional Ileitis; by Burrill B. Crohn, and Harry Yarnis, Grune & Stratton, New York-London. 1958.

Who is better qualified to write a book on Crohn's disease than Crohn? The book reports Dr. Crohn's experiences with more than 700 cases of regional ileitis. Despite this, the book contains few answers to specific problems. One gets the impression that little new information has been accumulated since the original description of the disease in 1932.

FRED M. HUNTER, M. D.

PUBLICATIONS RECEIVED

Doubleday & Co., N. Y.: The Cigarette Habit: A Scientific Cure, by Arthur King; The Teen-Age Years, by Arthur Roth, M. D.; The Reluctant Surgeon: A Biography of John Hunter, by John Kobler; Your Heart—A Handbook for Laymen, by H. M. Marvin, M. D.

Grune & Stratton, N. Y.: Diagnosis and Treatment of Tumors of the Chest, sponsored by the American College of Chest Physicians and edited by David M. Spain, M. D.

The C. V. Mosby Co., St. Louis: Textbook of Otolaryngology, by David D. DeWeese, M. D., and William H. Saunders, M. D.; Drugs of Choice 1960-1961, edited by Walter Modell, M. D.

W. B. Saunders Co., Phila.: Current Therapy —1960, edited by Howard F. Conn, M. D.; Christopher's Textbook of Surgery, edited by Loyal Davis, M. D. (7th edit.).